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Color Recognition and Color Changes in Certain Species of Fishes

By Ellinor Helene Behre

Introduction

THE capacity of many animals to change color has been studied repeatedly and from many angles. This capacity has been generally attributed to the sensitiveness of the visual apparatus to colors and the transmission of the stimulus there received to certain pigment groups or pigment units in the skin, probably through the mediation of sympathetic nerve fibers. It becomes a matter of some interest to determine how narrowly the visual apparatus and its sending mechanism can distinguish between lights of various wave lengths. Work done by Hineline (1919)[1] (1927)[2] and others[3] tends to show that in certain fishes the eye can distinguish and the voluntary muscle respond to small differences in wave length of light rays, though it fails to distinguish between blue (400 to 450 millimicrons) and green (510 to 550 millimicrons). The experiments here reported were designed to test further the efficiency of the mechanism of chromatophore control within as close limits as those proved effective for voluntary muscle. Mast (1914)[4] in his comprehensive work did not attempt to determine the actual wave lengths of the light serving as the stimulus. In the experiments reported below an attempt was made to repeat such tests with light of known wave length.

Materials and Methods

During the summers of 1926, 1927 and 1928 preliminary studies were made on a number of species of fishes at the laboratory of the United States Bureau of Fisheries at Beaufort, North Carolina,[5] with a view to selecting several species sufficiently responsive to serve as good test material. In August, 1926, these tests were made with daylight, ordinary broad daylight from an unshaded south window falling directly upon the light filters. As the weather proved fairly constant, this seemed at first a reasonably good working basis over a comparatively short period of time. But to reduce the source of light to a mathematical constant of known value, a Mazda lamp was used in the later experiments (July and August, 1927, and September, 1928) as a source of light in a small light-proof box communicating with a large light-proof box by a two-inch opening, over which the light filters could be inserted at an approximate distance of 12 inches from the lowest level of the shallow aquaria.

[1] White, Gertrude Marean, Jour. Exp. Zool., 27 (4): 443-498.
[2] Hineline, Gertrude Marean, *ibidem*, 47 (1): 85-94.
[3] For full bibliography see elsewhere.
[4] Mast, S. O., Bull. Bur. Fish., 34, Doc. No. 821, 1914.
[5] It gives me great pleasure to acknowledge my indebtedness to the United States Bureau of Fisheries for working space in the laboratory at Beaufort, North Carolina, during the progress of these studies, and especially to the Director, Doctor S. F. Hildebrand, and his able staff for friendly cooperation and assistance in collecting and in the arrangement of the equipment.

For most of the experiments the Mazda lamp was a 40-watt lamp. In a few cases especially noted, a 75-watt Mazda lamp was used in the hope of producing more rapid responses and thus allowing more tests in less time; for it was very evident, in certain of the cases at least, that responses were tremendously influenced in speed and extent by vitiation of the water in the aquaria in which the tests were made.

It seemed possible that results obtained in 1926 and 1927 might have been due to differences in intensity of the light rays transmitted through the filters rather than to qualitative differences in the wave length of the light. During September, 1928, therefore, the apparatus was modified by the addition of an infra-red glass cell containing a 3 per cent sulphate solution which was inserted between the light filters and the 100-watt tungsten incandescent lamp, which was used as the source of light; and by the calibration of all the light filters to a constant of transmission of radiant energy through the interposition of the appropriate neutral tint films.

Determinations of pH were frequently made and those experiments during which the pH showed a decrease of more than 0.4 were subsequently thrown out. The tests were made in the dark box in aquaria on a white non-luminous background between white non-luminous walls. The distance from the light filters to the surface of the water was about 8 inches and the aquarium was sufficiently small and so placed that the fish could not escape the direct light. When entire darkness was desired the opening was covered with a black felt slide. Heat from the light was practically negligible, as determined by repeated comparison of the temperatures of the water table with those of the test aquaria.

The filters used[6] and their wave lengths as given by the Eastman Kodak Company are as follows:

% Uncorrected Transmission	Descriptive Term and Number	Wave Lengths, Millimicrons
22	Red, 25A	580 to 700
15	Minus Red, 44	285 to 585
1	Blue, 49C	360 to 490
83-74	Minus Blue, 15 superimposed on 8	505 to 700
4	Green, 62	510 to 575
18	Minus green, 31	320 to 495 and 580 to 700

For convenience these filters will be referred to by their descriptive terms, as minus red, blue, minus green, etc., rather than by number or letter.

The tests were made sometimes on single fishes and sometimes on groups. When numerical results are reported each fish is reckoned as one test in the total count. The time was varied but was usually a short constant interval in any one test or series of tests.

At first a large number of species were given preliminary tests to determine their general responsiveness. The list of such species used during the three summers follows:

[6] For advice in the selection of the filters used and for their later calibration to a radiant energy constant, I am indebted to Mr. Lloyd A. Jones of the Physics Department of the Research Laboratory of the Eastman Kodak Company.

Order Iniomi—The lantern fishes
Synodontidae—Lizard fishes
Synodus foetens (lizard fish, sand pike)
Order Lophobranchii—The tuft-gilled fishes
Syngnathidae—The pipe fishes and sea horses
Syngnathus floridae (pipe fish)
Syngnathus louisianae (pipe fish)
Order Percomorphi—The typical spiny-rayed fishes
Labridae—The labrids or wrasses
Tautoga onitis (oyster fish or tautog)
Monacanthidae—The file fishes
Monacanthus hispidus (fool fish)
Sparidae—The scups
Archosargus probatocephalus (sheepshead)
Carangidae—The cravallés, pámpanos, etc.
Selene vomer (moon fish)
Order Cataphracti—The mail-checked fishes
Triglidae—The sea robins or gurnards
Prionotus tribulus (sea robin)
Order Jugulares—The jugular fishes
Blenniidae—The blennies
Hypleurochilus geminatus (blenny, sea-weed fish)
Hypsoblennius hentz (spotted sea-weed fish)
Chasmodes bosquianus (banded blenny)
Order Heterosomata—The flatfishes
Pleuronectidae—The flounders
Paralichthys dentatus (summer flounder)
Lophopsetta maculata (window pane)
Soleidae—The soles
Trinectes maculatus [*Achirus fasciatus*] (hog choker, sole)
Cynoglossidae—The tongue fishes
Symphurus plagiusa (tongue fish)

It will be noted that this list consists of representatives of 6 orders, 10 families, and 15 species in all. General observations on all groups studied are given below. On account of ease of manipulation, wideness of distribution, or sensitiveness to stimuli, several species were studied more intensively than the rest, and these form the basis for the more specific conclusions on this paper.

Preliminary and Scattered Observations

The preliminary observations at once eliminated a number of the species from further tests. Although the pipe fishes undoubtedly vary much in color within species, in these tests the variations were so slight as to be immeasureable, unless very large numbers were used at once; even then the gradation between individuals were too minute for generalization. Red on the whole seemed to darken and intensify colors previously dulled by keeping the specimens for some time in the dark. It also appeared that sea lettuce (*Ulva*, sp.?) in the water tended to hasten this effect.

Archosargus probatocephalus (the sheepshead) and *Selene vomer* (the moon fish) were also given up very promptly. No laboratory test could be found that would affect the color of the sheepshead, though the differences in shade of many small specimens picked up in the minnow seine had raised great expectations. The color of the moon fish is so definitely something superimposed on the metallic luster that it would seem to make interesting material, especially if the study were reinforced by histological examinations; but unfortunately not enough material of this species was available. The sea robin was also eliminated due to scarcity of material and the extreme individual variations; the few examples available differed considerably from each other, but the pattern of each was so extremely

complex that the changes, even could they have been accurately estimated, would be hard to reduce to type.

Of the flatfishes several were tested (*Paralichthys dentatus, Lophopsetta maculata, Trinectes maculatus, Symphurus plagiusa*), in an attempt to correlate response to colored light rays from above with Mast's findings regarding their response to color backgrounds. Oddly enough, though Mast got responses to colors of background in *Paralichthys dentatus* in less than 30 minutes, I was unable to observe any changes due to colored light in the same length of time, though the *Paralichthys dentatus* examples tested by me had darkened appreciably when brought from the dirty tan bottom of the water table to the black background and bright daylight of the laboratory desk.

Synodus foetens (the lizard fish) in preliminary tests appeared promising, since it varied under different background conditions much as the flat fishes seemed to do. When it was tested in the dark box with the

TABLE I

Effect of Different Colored Lights on Pale and Dark Phases of *Monacanthus hispidus*

	Effect on Dark Phase			Effect on Pale Phase		
Light Filter Used	Number Fading	Number Unchanged	Number Darkening	Number Darkening	Number Unchanged	Number Fading
Minus Blue	39	21	0	24	8	0
Red	67	5	0	8	16	0
Minus green	81	4	0	48	0	0
Minus red	42	0	0	36	0	0
Green	58	23	0	38	0	0
Blue	40	0	0	0	16	8

colored lights against darkness and against full illumination it did show considerable capacity to change, but no stable specific response to a particular stimulus. This may have been due to the slowness of reaction of the fish; conceivably, the test periods being of necessity rather short (on account of the vitiation of the water), the animals may have been still responding to the first stimulus after the second was applied (see discussion below). Further experiments with some type of apparatus that would make possible longer test periods might clear up this point. On the whole, there seems to be in this fish a general tendency to sharpen the pattern as the light proceeds from darkness to light and from the blues toward the reds; but evidence is not complete.

Tautoga onitis (the oyster fish or tautog), of which a number of small specimens were tested individually, responded very definitely to changes in the total illumination. Entire absence of light tended to reduce the intensity of all the colors; bright daylight tended to enhance it. Colored lights induced two types of responses: (1) paling of color, with a greenish tint, and (2) darkening, with a reddish brown cast. Blue induced the first type of response, while minus blue and red induced the darkening and reddening. Due to its very wide range, minus green might be expected to be almost as effective as daylight itself, and this seemed to be

the case. It also appears that the effect of any one color modifies that of the one next used; in other words, red produced more nearly a daylight response when following blue than when used after green, which is much less effective as a paling factor. Red also failed to produce the maximum effect obtainable by daylight, as was proved by following it by daylight, which induced a still further intensifying.

The preliminary results indicate that *Monacanthus hispidus* is not responsive to changes in illumination but that its color is modified by its material environment. Responses to the environment were very rapid, though not readily taking the form of tendencies to match a background: with dark green algae and *Ulva* the color tended toward green, but with brown and red algae the fishes became pale and dull and sometimes even bluish, not reddish or brown. Several records carried through extended periods of time indicate that the resultant colors in the fishes had but

TABLE II

Preliminary observations (approximately ten tests each) on the effect of light of varying wave lengths on dark and pale phases of *Hypsoblennius hentz,* 5 to 10 minute test periods.

Light Filter Used	Effect on Dark Phase	Effect on Pale Phase
Red	Paler	Darker
Minus Red	Paler (?)	No change
Green	Paler (?)	Darker or Unchanged
Minus Green	Paler	Paler or Unchanged (? Time Element)
Blue	Paler	Paler or Darker
Minus Blue	Paler	Darker or Unchanged

very slight stability, reverting on removal of the stimulus to the more usual shade in a shorter time than it took to set down the container. Later on, certain tests repeated with the colored lights indicated a slight tendency of the colored light to influence the color changes in the direction of sharpening in the case of the red and the minus green, and dulling and fading in the case of the minus red and the blue. There were, however, but few fishes in each test, and therefore the evidence is not conclusive.

In September, 1928, a series of further experiments were run on this species, with careful counts. The results obtained are formulated in Table I. Those rather more specific numerical results serve to indicate that in a general way the blue end of our spectrum is almost as effective as darkness in fading dark fishes, the other end nearly as effective as daylight, in darkening pale ones.

Color Changes in Blennies

The most striking and complete records were obtained from studies on the blennies *Hypleurochilus geminatus* and *Hypsoblennius hentz.* Too few of *Chasmodes bosquianus* were used to give detailed results. All of these species are on the whole darker and more intense in daylight, paler and duller at night, or in the dark. *Hypleurochilus geminatus,* in fact, when picked up from the water table in a dark laboratory from one to two

hours after sunset, was almost completely colorless. The tests were made in both directions, that is, from darkness and from daylight to the color tested.

The tests on *Hysoblennius hentz* show in a tentative way (see Table II) that red and minus blue fade dark fishes and darken pale fishes; that minus green fades dark fishes and does not affect light ones to any considerable extent; that minus red and green do not have any appreciable effect on either light or dark animals; and that blue fades dark fishes somewhat but acts much more slowly than the colors at the other end of the spectrum.

Hypleurochilus geminatus proved so responsive that a large series of tests was made with it. It became almost immediately apparent that red, minus red, and minus blue darken fishes in the pale color phase, while minus green, blue, and green cause dark fishes to become paler. It was assumed that this effect was specific, and a similar result was expected

TABLE III

Effect of Light of Varying Wave Lengths on Dark and Pale Phases of *Hypleurochilus geminatus*

		Effect on Dark Phase			Effect on Pale Phase		
Light Filter Used	Wave Length	% Fading	Rate	Number of Cases	% Darkening	Rate	Number of Cases
Red	580-700	10.7%	—	103	86.4%	Rapid	81
Minus Red	285-585	29.2%	Slow	89	76.5%	—	85
Green	510-575	21.1%	Slow	104	61.0%	Slow	100
Minus Green	320-495 580-700	18.2%	—	126	61.5%	Very Slow	39
Blue	360-490	49.8%	Very Rapid	159	54.9%	Fairly Rapid	95
Minus Blue	505-700	24.2%	—	—	86.6%	Rapid	89

from the reverse experiments: testing what seemed to be the darkening colors on fishes already dark, or what seemed to be the lightening or paling colors on pale fishes. I expected to get no change from the maximum darkness or paleness. This last expectation was unfulfilled. During the working season of 1927, red, though causing pale fishes to darken in 86.4% of the cases studied, is distinctly less effective than daylight and occasionally causes fishes of the maximum darkness to fade. Similar tests made with other colors illustrate the same point. The results are given in Table III, the summary of all the exact tests made in both directions with a constant source of light during the summer 1927. The table does not show exact differences in *rate* of change, since the rate varied at different times, probably due to differences in wattage of light source or differences in temperature. But the existence of such differences and their general direction is recorded in the appropriate columns of the table. The percentages are based upon the total number of tests, including those which show no changes.

During September, 1928, the same type of experiment was repeated with the filters standardized for total energy transmission. The results are shown in Table IV. Since the numbers are small actual total count rather than percentages is here given.

It will be noted that the most effective darkening colors fade dark fishes, the most effective fading colors darken pale ones. The tests as stated above were usually made by subjecting to colored light fishes which had previously been darkened or faded by exposure to the extremely bright daylight or absolute darkness. This being the case, it would appear that the effect of the particular colored light used was dependent on the light to which the fishes had been subjected just previously. In order to check these results more closely a small series of tests were run on a different plan as follows:

Fishes were set under one light filter for a considerable time—as long as experience had shown, in earlier tests, that the fishes usually take to reach their maximum change. The filter was then changed for another and the effect recorded. The numbers are small, but the results, as shown in Table V, are suggestive. Take for instance the tests with the blue filter. Blue and minus blue are at opposite ends of the series as regards their wave lengths; and blue actually fades a very much larger proportion of those fishes previously exposed to minus blue than of those first

TABLE IV

Further Data on Effect of Light of Varying Wave Length on Dark and Pale Phases of *Hypleurochilus geminatus*

Light Filter Used	Effect on Pale Phase			Effect on Dark Phase		
	Number Darkened	Number Unchanged	Number Faded	Number Faded	Number Unchanged	Number Darkened
Minus Blue	17	11	4	18	24	0
Red	12	0	0	11	25	0
Minus Green	12	0	0	4	7	0
Minus Red	13	2	0	10	5	0
Green	6	18	0	7	17	0
Blue	12	6	0	6	6	0

exposed to red. Again if we compare the effect of the blue filter (wave lengths 360-490 millimicrons) when following green (wave lengths 510-575), the point is still better brought out; minus blue is most like daylight, red next, green least. As might be expected, blue fades those specimens from the minus blue filter most, those from the red filter next, those from the green filter least.

One factor influencing *rate* of change, the hydrogen ion concentration, has been touched upon above and may be given further emphasis here. It was repeatedly noticed, not only in *Hypleurochilus geminatus* but in other forms as well, that vitiation of the water produced great irregularity in response of otherwise dependably responsive forms. In the course of almost any test carried over a period of more than an hour in water volumes of approximately fifty times (or less) that of the fishes, the test animals would become refractory. Return to fresh sea water usually resulted in partial recovery; but fishes once depressed by lowered pH to the point of blotching or irregular fading recover very slowly and seem unequal to responding to subsequent stimuli over a period of at least three days after return to sea water of standard pH. The register

of this reduced physiological condition in terms of color change varies considerably in the different species studied; *Monacanthus hispidus,* for instance, fades and turns homogeneously bluish; *Hypleurochilus geminatus* becomes heavily but irregularly mottled.

Discussion and Conclusions

The data here presented indicate that certain species of fishes distinguish between light rays of different wave lengths and between these and daylight or complete absence of light; and that they register their perception by color changes.[7] The response may be to colored light received from a colored background, or to direct illumination. Some species respond to one type of color stimulus better than to another. Among related groups living in the same habitat some species seem to lack this power of perception or of adjustment to such perception. Since all responses of any sort seem similarly directed and differing only in degree, the data of our most complete series of tests, those on *Hypleurochilus geminatus,* may be considered representative. It is this material which is presented in summary in Tables III to V.

TABLE V

Effect of Previous Light Exposure on Subsequent Response of *Hypleurochilus geminatus* to Colored Light

Original Exposure	Changed to	Number Darkening	Number Unchanged	Number Fading	Original Exposure	Changed to	Number Darkening	Number Unchanged	Number Fading
	Minus				Minus				
Blue	Blue	18	0	3	Blue	Blue	1	3	26
Blue	Red	5	0	14	Red	Blue	0	10	9
Minus	Red	9	8	8	Red	Minus			
Red	Green	32	10	73	Green	Red	8	8	7
Blue	Minus				Minus	Blue	19	78	29
Green	Green	11	7	85	Green	Green	12	72	28

The percentage results as calculated include the unresponsive cases as well as those showing distinct change in either direction. Percentages would run much higher if calculated on the basis of only those fishes which do respond. Had more time been allowed, many of the unresponsive cases would doubtless have run over into the "darkening" and "lightening" column; for many tests on time showed that further changes in the expected direction often followed longer exposures than the usual five minutes. However, no reversals of a color change once that change had begun in a certain direction are recorded, with the exception of such cases as those referred to on p. 53. The fishes of that series, having been in the laboratory for some time, proved to respond more slowly than usual to the stimulus. Even the 15 minute periods were apparently not sufficient to produce the usual change, and the change continued in the direction in which it was started by the first stimulus even after the second stimulus

[7] In two species at least, *Monacanthus hispidus* and *Hypleurochilus geminatus,* this capacity is not affected by blinding the fish in one eye, but is lost entirely, as would be expected, by complete blinding. There is no recovery through a period of at least three weeks.

was applied. The day book for the period illustrates this well in the comment repeatedly made to the effect that "after five minutes in new conditions the material examined showed slightly further change in the direction expected as a result of the *earlier* stimulus". "Thereupon, the material tested was left for longer periods," say up to fifteen minutes, and "during the last ten minutes began to show the influence of the new conditions." The table to illustrate this point is omitted. The influence of the time factor would probably be even greater in the records of other species which appeared less responsive. As has been suggested above, it may well be that some of these species would show definite changes if the tests could be extended over longer periods of time. The time element is further illustrated in Table II, which summarizes experiments in which the test periods were definitely limited. The data from which this table is compiled show many such points, as that indicating the effect of blue filter on the pale phase. This experience indicates that the response *rates* vary, and suggests that further study of the histological features might prove illuminating.

There is one phase of the time element that is worth commenting on. It is that the laboratory apparently produces in animals a condition that makes them less responsive. Repeatedly it was observed that animals freshly collected were much quicker to respond than those which had been in the laboratory longer. Just what bearing this has on the question of the mechanism of color change may only be conjectured.

An interesting fact appears from examination of Table V. It seems that the relative efficiency of any two closely related colors in producing a color change varies in the same way if they are used after a fading color as it would were they used after complete darkness. For example, minus blue is as much more effective than red as a darkening factor if following exposure to blue as it is if following exposure to complete darkness.

The light filters used seemed to affect all fishes tested fairly consistently in the same order, namely, daylight being the extreme darkening factor and absence of light the extreme fading factor. The filters used can be arranged in a series with minus blue next to daylight in darkening capacity, then red, minus green, minus red, green, and finally blue, which is most effective as a fading factor only surpassed by complete darkness.

Of this series the middle several have less decided effect than those at either end of the series. Minus blue is a darkening stimulus, blue on the other hand is most effective in inducing paling. Now minus green supplies two series of light waves, some short, almost exactly like those of blue, and some very long, nearly duplicating those of the red and not very far from those of minus blue. The difference between its effectiveness and that of the red or minus blue on the one hand (darkening) and that of the blue on the other (fading) can be most readily accounted for on the assumption that its composite nature prevents either set of light waves from functioning unchecked; in other words, there is herein demonstrated the modifying effect of each of the two groups of light waves of this filter upon the other. It is from this filter, then, that we get the best

evidence as to the probable function of the varying lengths of the light waves in modifying the colors of the fishes.

Analyzing the data further, it is equally evident that the comparatively low efficacy of the minus red can be explained also as due to the wide range of its wave lengths, and that the greater wave lengths of some of the light rays of the green can be explained as the factor responsible for its lesser efficacy as a paling factor.

Summary

1. Certain species of fishes can distinguish between light rays of different wave length and between these and daylight or complete darkness, and can record their perception by changing colors.

2. In two species at least, *Monacanthus hispidus* and *Hypleurochilus geminatus,* this capacity is not affected by blinding the fish in one eye, but is lost entirely, as would be expected, by complete blinding. There is no recovery through a period of at least three weeks.

3. A pH of less than 7.8 produces in all the species studied considerable indication of distress and bad physiological conditions, and, if the fishes are allowed to remain in sea water of low pH for any considerable period of time, they will die. Fish once depressed by such lowered pH recover very slowly and seem unequal to respond to subsequent stimuli over a period of at least three days after return to sea water of high pH. The register of this reduced physiological condition in terms of color change varies considerably in the different species studied. *Monacanthus hispidus* fades and turns homogeneously bluish; *Hypleurochilus geminatus* becomes heavily but irregularly mottled.

4. The six light filters used in these experiments seemed to affect all fishes tested fairly consistently in the same order. Daylight was the extreme darkening factor and absence of light the extreme fading factor. The colors fall into line with minus blue, red, minus green, minus red, green, and blue leading toward complete absence of light as fading factors.

5. Since the three colors minus red, green, and blue seem on the whole to tend to fade fishes, blue most definitely, the conclusion is drawn that the short wave lengths are the fading elements.

6. Minus blue, red, and minus green belong to the darkening end of the series; of these minus green is almost the exact counterpart of red, except for the second set of light waves, those between 320 and 495. Minus green with some very short wave lengths is on that account actually much less effective than either minus blue or red. It is clear then that the red end of the spectrum, or long wave lengths, is responsible for darkening, and that in combination the short wave lengths counteract this effect.

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Fishes of Avatcha Bay on the Southern Coast of Kamtchatka

By A.M. Popov

IN the summer of 1930 I made investigations in the bay of Avatcha on the eastern coast of Kamtchatka, as scientific specialist in ichthyology and hydrobiology. My investigations were concentrated for the most part in the large Avatcha Bay, which is about 13 miles in length and 3½ miles in width. The bay is connected with the open sea by a strait about 4½ miles wide and 1½ miles long.

The greatest depth of this shallow bay is no more than 30 meters. The upper part of the bay is very shallow (3 to 5 meters). The temperature and salinity differ slightly from those of the open sea, except in the upper part of this bay and in a small inner bay, where the rivers Avatcha and Paratunka discharge. Mud floors almost all the middle part of the bay and it disappears only near the coast, and again appears in the upper parts of the small inner bays. Near the coast the bottom changes to sand, stones and other materials. The littoral part of the shores is mostly stony, but in small bays it is sandy and muddy.

The fish fauna of Avatcha Bay has been very slightly studied. The first data were secured by Pallas and some other naturalists of his time. Following investigations were made by Grebnitzky in 1887, and by Bean in 1888, who worked up the specimens gathered by Stejneger and Grebnitzky. A series of forms were listed by Jordan and Gilbert, from the collections of the *Albatross*. Many other species were also recorded from Avatcha Bay by Schmidt in 1904. Lastly, in 1931, a paper by Rendahl was printed about the fish fauna of Kamtchatka. His paper lists 35 forms, almost all taken by the Swedish Expedition in the Bay.

However, all those investigations touched the bay only incidentally, without leading to a general list of fishes of this interesting bay. The approximately one hundred hydrobiological collections made by me provide rather rich ichthyological material, which has been studied by me. The collection contains 47 species:

1. *Oncorhynchus kisutch* (Walbaum) occurs everywhere in the bay. It enters the river from the bay about the month of August and especially in September, and is caught in the Avatcha and Paratunka rivers in December and January.

2. *Oncorhynchus keta* (Walbaum) also occurs everywhere in the bay. It enters the rivers in July and August, and great quantities are to be found by the end of August.

3. *Oncorhynchus nerka* (Walbaum) is very common in the bay from June to August. Its migration coincides with that of *keta*. This species is very common along the entire coast of Kamtchatka. Two forms are to be distinguished in Paratunka River: the river one which enters all the rivers of the bay, and the lake form which is smaller and is found only in the Paratunka River system.

4. *Oncorhynchus gorbuscha* (Walbaum) is also very common in the bay and is of great importance in the native fishery. Its migration lasts from June until the second half of August, and it goes very far up the river.

5. *Oncorhynchus tshawytscha* (Walbaum) is a common kind of fish in Avatcha Bay, though I have no specimen in my collection. Its spawning begins early in spring.

6. *Salmo mykiss* Walbaum.—This species of the genus *Salmo* is common in the Paratunka and Chalaktirka rivers, and in all other rivers and lakes in the drainage basin of Avatcha Bay. By having a long upper jaw and a pink streak along the middle of its body, as well as by other peculiarities, it may be easily distinguished from other species. The species described by Jordan and Gilbert under the name of *Salmo mykiss* Walbaum from Chalaktirka is *Salmo penshenensis* Pallas.

7. *Salmo penshenensis* Pallas.—Since this species was described by Pallas from the eastern coast of Kamtchatka, it has not been noted by anyone except Jordan and Gilbert, who wrongly identified their specimens as *S. mykiss* Walbaum. It enters the river in autumn, along with the beginning of the run of *Oncorhynchus kisutch*. This fish is known under the name of "semga" (salmon), and occurs in Chalaktirka River as well as in different parts of Avatcha Bay. It is fished in the bay at the Solevarka.

8. *Salvelinus alpinus malma* (Walbaum) is very common everywhere in the bay of Avatcha. In my collection there are specimens from Poganka River and from the sea near Petropavlovsk. Many young ones were taken in small lakes and brooks on July 30. Some very small specimens of the genus *Oncorhynchus,* from the small river falling into Chalaktirka Lake, differ from very young of *Salvelinus alpinus malma* in their elevated bodies, and I think that they are *O. gorbuscha.*

9. *Salvelinus leucomaenis* (Pallas) is everywhere in the bay and is common. The spawning season along the coast of Avatcha Bay is the second half of summer.

10. *Mesopus olidus* (Pallas) has a very wide distribution along the coast of Avatcha Bay, and is also found in the lake on the peninsula of Tarinsky, in Rakovaja Bay and elsewhere. In Avatcha Bay it is fished all year long. In August and September great schools of young fish are to be found off the coasts of Avatcha Bay.

11. *Clupea harengus pallasii* Cuvier and Valenciennes is found in many localities in the bay. It is not abundant all the year, but only when it enters the bay for the purpose of depositing its ova. Several runs are distinguished, but usually it appears in great numbers only in the spring. The herring fishery is of importance along the eastern coast of Kamtchatka northward to Korf Bay. I think that the herring spawns in Avatcha Bay early in the spring. Young herring have been found

in August, and they remain near the coasts. At this time, the schools of herring are everywhere in Avatcha Bay and provide good food for the many fishes and birds in the bay. In addition to these young-of-the-year herring, 1 to 2 or more cm. long, there are also found in the summer larger young, which are probably one year old. These young herring are called "kilka" by the natives and appear each year in the middle of summer. I think that the young fish after hatching from the eggs in the bay, migrate to the sea in autumn, where they pass the winter and return to the bay next year about one year old. They find in the bay good food, which helps them to grow very fast.

12. *Myoxocephalus jaok* (Cuvier and Valenciennes) is very abundant in the bay, near Petropavlovsk, in the mouth of the Rakovaja Bay and elsewhere.

13. *Myoxocephalus polyacanthocephalus* (Pallas).—Specimens were found near Petropavlovsk, at Signalny Cape, and elsewhere. This species has no scales, but only several small dermal warts on the body.

14. *Myoxocephalus stelleri* Tilesius was met with near Petropavlovsk, in Rakovaja Bay, on bottom overgrown by *Zostera*, in a lake which has a connection with the sea. This species may be easily distinguished by the marbled design on the membranes of its upper lips and on the chin. The upper part of its head is covered with dermal warts.

15. *Megalocottus platycephalus* (Pallas) occurs everywhere in the bay. Specimens were found in the river north of "Babushkin's Stones", in the lake near Petropavlovsk, the lake on Tarynsky Peninsula and elsewhere. The upper jaws are shorter than the lower ones. The head is rather flattened, and its upper part is covered with warts. A pair of well developed bony crests occur on the nape. The plates are well developed on the lower sides.

16. *Porocottus sellaris* (Gilbert) was found at 51° N., 162° 56′ E., near Petropavlovsk. All the specimens examined by me differed greatly from the typical specimens of this species. The hind protuberance on the nape is represented in the form of supplementary dermal parts. The distance between these protuberances and the origin of the dorsal fin is a little longer than in typical individuals. The nape, just behind the eyes, is strongly concave. Along the body there are two rows of pores. In the caudal part of the body and below the lateral line there is a series of short protuberances, looking like whitish spots. The space between the eyes is concave. The body is crossed by 2 to 3 slanting stripes. Some dermal flaps occur along the lateral line. Should these differences be confirmed the Kamtchatkan form may require a new name.

17. *Gymnocanthus detrisus* Gilbert and Burke.—One specimen was taken from the mouth of Avatcha Bay on October 12, in the muddy area overgrown by *Zostera*. The eyes are large. On the pectoral fins are two wide black bands. *Gymnocanthus pistilliger* has several dark bands on the pectoral fins.

18. *Gymnocanthus pistilliger* (Pallas). Numerous specimens were taken by us in many localities and habitats, such as: lakes on Tarynsky Peninsula, on sandy ground; Tarynsky Bay at a depth of 6 to 10 meters; mouth of Avatcha Bay on muddy and sandy ground; Rakovaja Bay on the bottom where overgrown by *Zostera;* near Mishennaya Mountain; near the "Kasak" Cape at the depth of 4 to 6 meters and at other localities. It is abundant also in the laminarian belt near Solevarka Bay.

19. *Triglops pingeli pacificus* Schmidt.—One young taken in Avatcha Bay.

20. *Hemitripterus americanus* (Gmelin) was found in Avatcha Bay, one mile off the mouth of the small Kalaus Bay near the Laida, at depths of about 4 to 6 meters, on sandy and muddy bottoms. It is very interesting to note that this marine species has been found in the region influenced by the fresh waters of the rivers Paratunka and Avatcha. In spite of its small size, only 54.2 mm., the one specimen obtained is a very typical one.

21. *Hemilepidotus hemilepidotus* (Tilesius).—One young specimen was found near the mouth of the Solevarka, at the depth of 10 meters, where the bottom is sandy and muddy.

22. *Enophrys diceraus* (Pallas).—Many specimens were taken in numerous localities: Tarinsky Bay at the depth of 4 to 8 meters, on stony ground; Kultuk of Tarinskaja Guba, near the cape of Artuschkin at the northern coast of the mouth of Tarinskaja Guba Bay; near the Solevarka at the depth of 10 meters on muddy ground; Seldenaja Guba across Tarinsky Peninsula, and elsewhere. The species is very abundant on the rocks along the coast of Avatcha Bay at the depth 4 to 12 meters. It was always taken from the rocks covered by Serpulidae.

23. *Artediellus pacificus ochotensis* Schmidt.—Numerous specimens were taken in Avatcha Bay where it is a very common and widely distributed species near the coast. It was found at the depth of 4 to 10 meters in the middle part of source region of Tarinskaja Guba, and in many other localities. It prefers to live on stony bottom, especially where covered with seaweeds and with tubes of Serpulidae. In that respect, it is like *Enophrys diceraus.* I have compared Avatcha Bay specimens with others from Okhotsk Sea, and find them the same. There are dark spots on the posterior part of the dorsal fin. The dermal flaps on the lateral line are pronounced only in the anterior part of the body. The pores on the head are very large, larger than those along the body. In addition to having a larger number of pores in the lateral line, this species may be easily distinguished from the *Artediellus camchaticus* by its shorter and higher caudal peduncle.

24. *Nautiscus pribilovius* Jordan and Gilbert.—Several specimens were taken in Avatcha Bay, near Petropavlovsk, from many localities along the Signalnaja and Nicolaevskaja mountains, from depths of 10 to 12 meters, on stony and muddy ground, and in other localities. The space between eyes is extremely concave. There are two pairs of protuberances

on the nape, and many large pores on the head. From the lower margin of the eye a stripe is directed downward. The body is completely covered with small prickles accompanied by a row of some larger prickles.

25. *Histiocottus bilobus* (Cuvier and Valenciennes) was found in the Avatcha Bay near Petropavlovsk.

26. *Blepsias cirrhosus* (Pallas) was found near Toporkof Island, at the depth of 4 to 6 meters, on stony ground covered by *Laminaria*. Dorsal rays VIII, 22; anal 18; pectoral 13. The lower jaw has 3 pairs of barbels and the upper one has only one pair. The ventral fin reaches the anal opening.

27. *Podothecus gilberti* (Collett).—Specimens were taken in Avatcha Bay, near Solevarka Harbor, where it is very abundant.

28. *Occa dodecaedron* (Tilesius) was obtained by me from the bay near Petropavlovsk. A young specimen was collected from a depth of 3 to 6 meters, one mile from the Kalaus Bay. It was found on sandy and muddy ground. Dorsal spines XI; anal rays 13; pectoral 15; ventral 1, 2.

29. *Pallasina barbata* (Steindachner) was found to be abundant everywhere in Avatcha Bay from the limit of the water mark out to a depth of several meters. Numerous specimens were taken from different localities especially in the places with *Zostera* and other seaweeds.

30. *Hypsagonus quadricornis* Cuvier and Valenciennes.—Numerous specimens were taken in the Avatcha Bay. It was found to be very abundant near the coast of Tarinsky Peninsula at Misennaja Mountain, at the depths of 10 to 20 meters, and elsewhere. Like *Enophrys diceraus, Artediellus pacificus* and other species, this form is most abundant on rocky sand. Many young specimens were to be found in dredging and trawling in shallow water near the coast, on stony ground.

31. *Pholis dolichogaster* (Pallas) was found ½ mile off the coast of Tarinsky Peninsula.

32. *Pholis pictus* Kner is abundant near Petropavlovsk Harbor.

33. *Opisthocentrus ocellatus* (Tilesius) was found in the lake connected with the sea, near Tarinsky Peninsula, at the depth of 2 to 6 meters, covered by *Zostera* on bottom. It is a common species everywhere along the coasts where the bottom is overgrown by seaweeds.

34. *Alectrias alectrolophus* (Pallas).—I found several specimens of this species among the collections made near Petropavlovsk by Mr. Grebnitzky. It is very abundant near the limit of water, under stones and in other places.

35. *Anarrhichas orientalis* Pallas was found by me in two places in Avatcha Bay (Rakovaja Guba and Petropavlovsk Harbor). It is a valid species described by Pallas and *A. lepturus* Bean is merely a synonym.

It is rather common in the bay, especially about the rocks where covered with tubes of Serpulidae, etc.

36. *Cyclopterichthys ventricosus* (Pallas).— A young specimen 9.2 mm. total length was found near the Solevarka in the mouth of Avatcha Bay, on ground overgrown by *Laminaria.* On its first dorsal fin a little crest is still to be seen. The grown fishes entirely lose this fin, as it becomes covered with the skin of the body. The discovery of the young of this species is of special interest, as until now only adult specimens have been known.

37. *Eumicrotremus orbis* (Gűnther) was taken rather rarely in the bay.

38. *Liparis,* species.—One specimen of a liparid, difficult to identify, 49.5 mm. in length, was found at the mouth of Avatcha Bay in the Solevarka region, where the bottom is overgrown by *Laminaria.* The sucker is 6.2 mm. in length. The head is 11 mm. long. The eyes are 1.5 mm. across. The space between the eyes is 4.8 mm. The upper jaw is longer than the lower one. The antedorsal distance is 14.2 mm. The pectoral fins are equally rounded and the lower part is somewhat separated from the upper part and surrounds the suckers in front and on its side. The pectoral fin reaches the base of the anal fin. The height of the body is equal to that of the pectoral fins. The color is grey.

39. *Hexagrammus stelleri* Tilesius.—I found this fish in considerable numbers in Avatcha Bay near Petropavlovsk Harbor, and at other places. The specimens fully correspond to the descriptions made by several authors; thus, for instance, scales occur on the head only behind the eyes on the upper part of preoperculum and operculum, and on the middle of the cheek, where there is also a group of scales. It should be noted that up to the present great importance has been attached to the character and number of lateral lines in the classification of Hexagrammidae. Thus, for instance, the joining of the abdominal lines of pores near the ventral fins was considered to be a characteristic feature of the *Hexagrammus octogrammus.* I have, however, noticed that among many specimens of *Hexagrammus stelleri,* there were several of the same kind, but having other peculiarities by which they could be distinguished from *Hexagrammus octogrammus.* My suggestion that we are dealing here with intraspecific variation in the lines was soon confirmed by the discovery of a whole range of changes in the forms of these lines. I have never met with *Hexagrammus octogrammus* in the Avatcha Bay and it may be supposed that Jordan and Gilbert in recording this species from Avatcha Bay, had only aberrant examples of *Hexagrammus stelleri* with their abdominal lines joined, as in true *H. octogrammus.*

40. *Limanda aspera* (Pallas) was found everywhere in Avatcha Bay.

41. *Liopsetta pinnifasciatus* (Kner).—A young example of this species, 46.9 mm. long, was found in Rakovaja Bay, on bottom overgrown by *Zostera,* at the depth of 4 to 8 meters.

42. *Platichthys stellatus* (Pallas) was found to be very common everywhere in the bay, and in adjacent places. It was found in many localities such as: Petropavlovsk Harbor, mouth of Avatcha River, in many lakes, etc. Numerous young examples were taken in shallow water near the mouth of Avatcha River. It is abundant on sandy and muddy ground, and often occurs in fresh water.

43. *Gadus callarias macrocephalus* Tilesius was found in numerous localities in Avatcha Bay. It is very abundant in the bay in the summer, but leaves it in the autumn. Specimens were taken at the depth of 3 to 4 meters near the isthmus of Tarinskaja Guba Peninsula near the village of Solevarka, at the depth of 4 to 6 meters. It was also met with on ground overgrown by *Laminaria* near Solevarka, and on sandy and muddy ground. This cod is caught in the bay as well as in the adjacent waters. It was fished for in year 1930 for the first time. In the spring and in summer it is abundant near Petropavlovsk, but it disappears in the upper part of Avatcha Bay, where the waters are considerably freshened. It is very interesting, that I obtained numerous young fishes at several stations (Nos. 2, 3 and 4). It proves that this cod has its spawning place near Avatcha Bay and it seems that the young fish are nourished in the bay. The adults leave for the purpose of fattening northward along the eastern coasts of Kamtchatka, as far as the isthmus of Kamtchatka and even farther northward. The young are very easily distinguished from the young of *Eleginus navaga* by the longer barbels on the chin. Apart from this their jaws are almost equal. Their eyes are large and their snouts long. The pectoral fins are shorter than those of the young *Eleginus navaga*. The space between the eyes is longer than or equal to the diameter of the eye.

44. *Eleginus navaga gracilis* (Tilesius) was found to be very common. It was taken by me in many localities: in Tarinskaja Guba Bay; in Rakovaja Guba Bay of Seldjanaja; near the village of Solevarka, etc. It is widely spread through the lakes of the shore of Avatcha Bay. In the spring it is abundantly fished for when it approaches the shores. In summer it keeps somewhat farther off the coast, but is still caught in the nets. There are many young fishes about 42 mm. long in the collection. The young were always caught in trawls and dredges in different places in the sea, along the shore of Avatcha Bay.

45. *Theragra chalcogrammus* (Pallas) is very common near Avatcha Bay.

46. *Gasterosteus aculeatus* Linnaeus.—Numerous specimens were found near Petropavlovsk, in the lake-bay of Saranaja, in the lake of Derjugina, and elsewhere.

47. *Pungitius pungitius* (Linnaeus) is very abundant at many places in Avatcha Bay. Found in Derijugina Lake at Saranaja Guba; in the Najachnoe Lake, and in the littoral lake of Rakovaja Bay. It is very common everywhere in the freshwaters of Kamtchatka.

As a supplement to the preceding list, we give below additional species recorded for Avatcha Bay and adjacent region by previous investigators, mentioned above:

Lamna cornubica (Gmelin)
Osmerus eperlanus dentex Steindachner
Hypomesus japonicus Brevoort
Mallotus villosus (Müller)
Myoxocephalus axillaris Gill
Myoxocephalus niger (Bean)
Icelus spatula Gilbert and Burke
Enophrys naniyci Jordan and Starks
Artediellus camchaticus Gilbert and Burke
Psychrolutes paradoxus Günther
Eurymen gyrinus Gilbert and Burke
Percis japonicus (Pallas)
Aspidophoroides bartoni Gilbert
Opisthocentrus quinquemaculatus (Kner)
Chirolophus polyactocephalus (Pallas)
Lumpenus anguillaris (Pallas)
Lycodes camchaticus Gill
Liparops stelleri (Pallas)
Liparis gibba Bean
Careproctus gelatinosus (Pallas)
Ellasodiscus tremebundus Gilbert and Burke
Hexagrammus lagocephalus (Pallas)
Hexagrammus octogrammus (Pallas)
Hippoglossus stenolepsis Schmidt
Hippoglossus hippoglossus camchaticus Rendahl
Lepidopsetta bilineata Ayres
Pleuronectes quadrituberculatus Pallas
Antimora microlepsis Bean
Ateleobrachium pteratum Gilbert and Burke

Adding these species to those obtained by me, we find a total of about 76 species reported for Avatcha Bay and adjacent regions in the open sea. I think that a number of other species will be found in the future in this bay, and especially in adjacent regions.

The collection of fishes gathered by me in Avatcha Bay has provided material for a good addition to the knowledge of the systematics and biology of the fishes of Kamtchatka. *Salmo penshenensis, Limanda aspera, Artediellus pacificus ochotensis, Porocottus sellaris,* and other species are interesting additions to the known fish fauna of the southeastern shore of Kamtchatka. The collection also determines which of those species are really common for the bay and which are rarer. It proves that Avatcha Bay, being the only shallow-water bay on the whole eastern coast of Kamtchatka, is very important in the biology of fishes of the adjacent sea. The cods, smelts, and flatfishes spawn commonly near the bay or in the bay itself. The young fish grow and feed in the bay, where the conditions are very suitable for them, as the water becomes much warmer in the bay than in the sea during the summer. It should be noted, that the young of the marine fishes bear the freshening of the water better than do the adults.

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An Analysis of Some of the Factors Influencing the Rate at which Species have been Described[1]

By Harley J. Van Cleave

THE growth of information concerning the classification of the North American fauna has received considerable attention in recent years in one of the graduate courses in Zoology in the University of Illinois. After considering the various factors and agencies influential in stimulating work in taxonomy, the writer has always wondered to what extent fortuitous circumstances might have been responsible for some of the golden eras of taxonomy commonly attributed to specific causes. It is not difficult to focus the attention so sharply on individual factors that the history of the subject loses its perspective in the restriction of attention to a few selected high spots. Each year, after the writer has lectured on the history of taxonomy, he has found himself wondering what kind of a curve might portray the rate at which new forms of life have been recognized for the country as a whole. A search of the literature failed to yield evidence that such a study had ever been published. Hence the excuse for the present paper which has as an object the analysis of the rate at which the North American fauna has been revealed to the world and the portrayal of that rate in the form of a graph.

A number of zoologists with whom the writer has talked have expressed the opinion that the law of diminishing returns operates in the realm of taxonomy. In any restricted locality, if the concept of and criteria for species remain static, the time comes when all the forms of the region become known and cataloged. In spite of this ideal condition, there are very few regions for which a complete faunal list is available. There are many regions, even in our own country, where only the larger and more conspicuous forms of life have been given attention by the taxonomists. Among even those groups of animals which have been considered as well known by one generation, the species become fragmented or at least are split into subspecies on the basis of new criteria in the hands of a younger generation of specialists. While this condition has developed in practically every group of the animal kingdom, it has become especially apparent in several classes of the vertebrates, the arthropods, and the molluscs. Some recent investigators, failing to recognize the inevitable necessity of drawing progressively finer lines of distinction to reflect morphological and biological inequality, bemoan the passing of the Linnaean species concepts. Few of the persons voicing such lamentations have given enough thought to the problem to realize that in every group with a long nomenclatorial history most of the early specific characterizations are little more than generic diagnoses, demanding generous interpretation of vague limitations for the recognition of the described species and delimitation from other species not known to the original describer.

The number of species and varieties described in the current litera-

[1] Contributions from the Zoological Laboratory of the University of Illinois, No. 440.

ture as new, forms no safe index to the rate at which valid species are being added to the faunal lists. David Starr Jordan (1928: 380) once said that each species of the fresh-water fishes of North America has been described as new, on the average of at least three or four times and similar fallacies abound in the literature of every group. Obviously, then, only a critical evaluation of the proposed specific names and an accurate determination of synonymy can provide the basis for determining the rate at which species and varieties have been added to the faunal lists. Furthermore, before meriting any claim of objectivity, large areas at least approaching the magnitude of faunal realms must be considered in a study of this sort.

Fortunately, critical check lists for the entire North American continent have been prepared for a number of the vertebrate classes. Stejneger and Barbour's *Check list of the North American amphibians and reptiles* (1923),[2] and Jordan, Evermann and Clark's *Check List of the fishes and fishlike vertebrates of North and Middle America* (1930) are recent, comprehensive lists in which synonymy has been painstakingly determined and dates for original descriptions of species are made readily accessible. The writer has used these two check lists in an attempt at analyzing the relative rate at which new forms have been described and authoritatively recognized.

In a preliminary study, the 590 species and subspecies of reptiles and amphibians listed in the Stejneger and Barbour list were tabulated in ten year intervals and the number of forms described in each decade was plotted as a frequency curve (Fig. 1). In this graph, the solid line depicts the total herpetological fauna, the broken line the amphibians, and the dot-and-dash line the reptiles. An examination of this graph indicated that instead of conforming to a normal distribution, the curves have numerous minor modes and lows. It would seem that the trend of taxonomy has its ups and downs. If highs and lows have any significance in these graphs they must be correlated with events and conditions both within and without the immediate history of science. One might be tempted to invoke the influence of fads in publication as described by Professor Stevens (1932: 499) to explain the successive periods of popular interest in and neglect of the field of taxonomy, but there are many other factors, besides the following of a popular lead, that influence the rate of publication in the field of taxonomy. Only a few of these will be discussed.

In the early days of systematic zoology, the lack of knowledge of satisfactory methods of preservation and difficulties of transportation operated in favor of the forms with pelts or with hard external coverings becoming known before those with soft skins. The fact may not carry great significance when it is stated that of all the Amphibia and Reptilia known for the North American continent down to 1923, approximately 4.6 percent were known to Linnaeus. But it becomes rather significant when we find that Linnaeus, in his tenth and twelfth editions of the

[2] The 1933 edition of the *Check List of the North American Amphibians and Reptiles* was published after this article was submitted.—Editor.

Systema Naturae knew 5.9 percent of all the American reptiles described down to 1923 but less than 0.7 of one percent of the amphibians of the same fauna were known to him. Ease of preservation of reptile skins was doubtless one of the prime factors in this disproportionate representation of the amphibians and reptiles which found their way across the ocean to the collections of Linnaeus. When we consider the fact that little more than the Atlantic seaboard has been touched by collectors up to 1758 and the entire west was unknown, it becomes significant to find that about 9.5 percent of the entire turtle fauna of North America bears names dating to the decade of Linnaeus' tenth and twelfth editions.

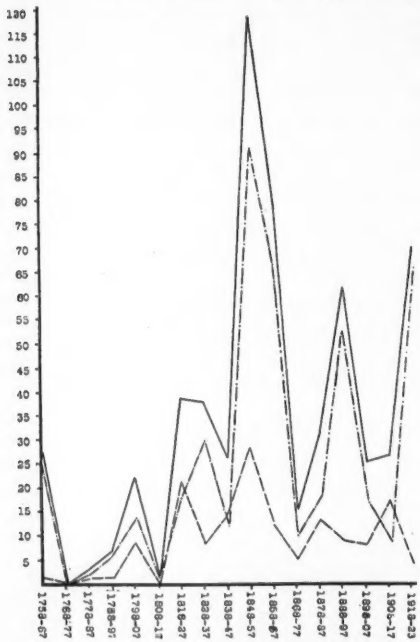

Fig. 1. Graph depicting the rate at which valid species and subspecies have been added to the herpetological literature for North America. Solid line, total of amphibians and reptiles taken together; broken line, amphibians alone; dot and dash line, reptiles alone.

An examination of historical and biographical data reveals the names of many herpetologists who brought prominence to the systematic literature. Green, Rafinesque, Say, Holbrook, Agassiz, Baird and Girard, Kennicott, Cope, Stejneger are all of them more than mere names attached to species designations. These men furnished the unstinted labors and the devoted enthusiasm through which other cooperating circumstances nurtured the spirit of research and made their respective decades memorable in the history of herpetology. Most of them worked under conditions radically different from those confronting the systematist of today. The pioneers who laid the foundations of North American herpetology were not permitted to make the rounds of a series of museums where specimens have been gathered by experienced collectors from every corner of the earth. Theirs was the privilege and the obligation of collecting specimens and field data at first hand in the then almost inaccessible regions of the unknown west. The various expeditions and surveys with which they served opened for their successors an unknown and uncharted fauna. As contributary elements favoring the advancement of the work of these leaders, were events in our civil history such as the Louisiana Purchase with the consequent stimulation of public interest in the lands beyond the Mississippi. This same popular interest led to the inauguration of the long series of government surveys and expeditions in whose

published reports the incidental faunal papers have deep significance in the history of the discovery of the American fauna.

Needless to say, the opening of avenues for publication was a most significant factor in extending the knowledge of our animal life. In the early colonial days there were no local publications whose pages were accessible for the printing of taxonomic papers. European periodicals were almost the sole avenue for publication of such works until a new era was inaugurated with the opening of the nineteenth century. Numerous societies and academies were then founded and private periodicals began to make their appearance. Some of these while only ephemeral had lasting influence on the literature of science, others have persisted as important avenues for publication through more than a century. One needs but to examine the initial volume of the Journal of the Academy of Natural Sciences of Philadelphia to appreciate the significant role which it played in offering an outlet for the energetic inquisitiveness of Thomas Say, C. S. Rafinesque, and Doctor Green in the unexplored field of American herpetology.

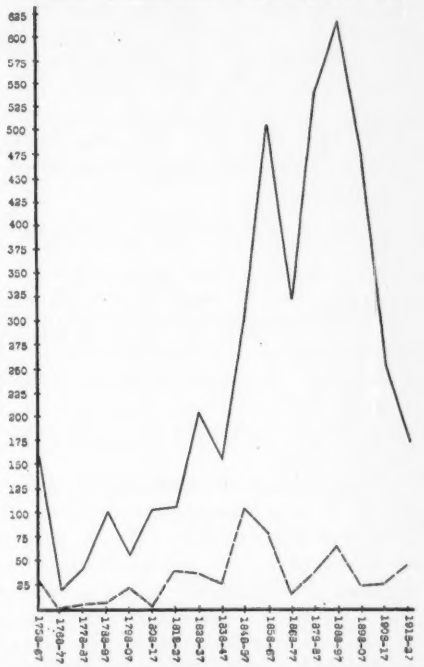

Fig. 2. Graph depicting the rate at which valid species and subspecies have been added to the ichthyological literature for North America. Solid line, the total for fishes; broken line the total for amphibians and reptiles on the same scale.

In the foregoing hurried review of the factors influencing the rate of recognition of our herpetological fauna, only those factors operating to increase knowledge have been mentioned. Factors of suppression must be operative, for the low points in Figure 1 seem to have as great significance as do the high. There was not a single valid species of amphibian or reptile described in the decade of 1768; the decade of 1808 was practically barren; the few species falling in the decade of 1868 seem especially paltry following the peak of the two preceding periods; and again, the diminution of numbers during the period from 1898 to 1917 marks a sharp decline. It happens that each of these low periods is shared by one of our more important wars and the state of economic depression which accompanies the state of war. The Revolution and reconstruction left little time for pure science in the two decades from 1768 to 1787. The War of 1812 and the Civil War mark the next two significant lows

in the curve. Both the Spanish-American War and the late World War share the extended period of low productivity in number of new species of Amphibia and Reptilia characteristic of the two decades starting in 1898 and 1908. It is not safe to intimate that war causes a decreased activity in the field of taxonomy. No direct causal relationship may be claimed in that direction any more than it might apply in the opposite direction of low scientific productivity causing war. Economic conditions accompanying war, the interruption of scientific pursuits for military service, reduction in funds available for publication are some of the correlative factors which directly suppress activity in the field of taxonomy during periods of war. We come to know our fauna better in times of peace. Perhaps the average citizen would not deem this another biological indictment of war.

After completing the preliminary study based upon the analysis of the history of herpetology, the writer was interested in finding if the apparent correlations for a small species list might apply for a larger group. The more than four thousand species and subspecies of fishes included in the Jordan, Evermann and Clark check list (1930) were subjected to analysis and the numbers of forms authoritatively recognized for each decade were determined. In Figure 2, the solid line depicts the profile of the rate at which fishes have been recognized in the North American fauna while the broken line gives the curve for species of amphibians and reptiles on the same scale.

Though there are marked differences in the modes, the two curves in Figure 2 show reasonable agreement. The periods of least activity in describing fishes coincide with the periods during or following the wars as in the graph for the amphibians and reptiles. The period of the Mexican War (1846-48) which accentuated a retardation already operating in the field of herpetology stands as clearly associated with a sudden break in the profile of ichthyological history.

The influence of leaders in the field of ichthyology is pronounced. Jordan and Evermann's *Fishes of North and Middle America* (1896-1900) stands as a monumental landmark distinctive of the most active period in the history of the subject for the continent. Linnaeus, Rafinesque, Le Sueur, Mitchill, De Kay, Girard, Gill, Townsend, Gilbert, Eigenmann, Garman, Goode and Bean, and the host of associated students and collaborators with Jordan and Evermann forged the framework of the systematic literature on fishes, in their respective periods joining with other factors to give the distinctive profile to the curve representing the progressive revelation of the fish fauna of America to the world. The climax of activity came a full generation later in the history of the work in ichthyology than it did in herpetology. In the same sense that the Baird and Girard catalogue characterized the golden maximum in herpetological investigation in North America, Jordan and Evermann's *Fishes of North and Middle America* (1896-1900) in a later generation is symbolic of the crucial point in North American ichthyology.

Fortuitous circumstances such as political and civil events, social and economic conditions, states of peace and of war, leadership or lack of

leadership, and even fads in following a popular lead in research have had their part in determining the rate at which the American fauna has been described. The composite result of these and the numberless factors is an irregular sequence of acceleration and retardation in whose hopeless jumble causal and correlative relationships are never clearly distinguishable. Only the indisputable influence of some individuals and their monumental contributions stand as unchallenged factors, but even these are far from simple factors in determining the course of taxonomy for the activities of the leaders may in turn be resolved into an endless chain of purpose and mere chance.

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Notes on *Scolecosaurus*

By T. Barbour

DURING the winter of 1931-32 Mr. Allison V. Armour's exploring yacht "Utowana" revisited the West Indian area and touched at several islands which were not visited during the 1929-30 cruise when I had the great good fortune to be aboard. A short stop was made at the Island of Cannouan and there Doctor David Fairchild and his associate Mr. H. F. Loomis took a specimen of *Scolecosaurus*. I have long been interested in this genus and I believe this specimen represents an hitherto unknown form, so slightly modified from the animal of Grenada that, quite inconsistently, I call it but a new subspecies although an overlapping of characters may not exist. Cannouan is dry and arid; Grenada is heavily wooded and very rainy.

Recently Mr. and Mrs. Burt (Bull. Amer. Mus. Nat. Hist., 61, 1931; 374) have reviewed the genus but they did not get at all the facts in the case by any means. The history of the name of the genotype follows:

Cuvier in the *Regne Animal* (1817, Vol. II: 57) discusses the genus *Chalcides* Daudin but he had no four fingered species among those he recited. Fitzinger, however, (Neue Class. Rept., 1826: 50) lists in his IX Familia, *Chalcidoidea,* the (3) genus *Brachypus* and species *cuvieri* and he calls it "M. Cuvier's Brachypus, Patria ignota." Why he associated Cuvier's name with the creature is now a mystery but the name is not as Burt states, a nomen nudum. Fitzinger, in his *Neue Classification der Reptilien* on p. 11 defines what he calls the family Chalcidoidea as follows: "Oculis palpebris muniti; palpebris duabus; gula non dilatabilis; corpus verticillatum; tympanum latens." Under this category he next proceeds (p. 20) to define, albeit meagerly, his new genus *Brachypus* with the significant words, "Plantae . . . . . tetra dactylae." Then on p. 50, in his setting forth of the reptiles preserved in the Vienna Museum, he establishes one species under his new genus *Brachypus* which is *cuvieri* of unknown provenance.

Brachypus is preoccupied but that is not relevant. The one and only species was diagnosed by the generic diagnosis plus the two later qualifying words. Dr. Stejneger, who has been over this ground with me, tells me that he is under the impression that the type was still preserved in the Vienna Museum many years ago but now Dr. Wettstein writes me that it cannot be found.

In 1829, Cuvier (Ed. 2, Vol. II: 66) lists, but fails to name, a form with four toes on all limbs. The generic description is quite unmistakable and Wagler in the very next year, 1830 (Syst. Amph.: 196), names the form "pedibus tetradactylis" by listing and including in his new genus *Chalcis,* which is adequately diagnosed, the species *Brachypus cuvieri* Fitzinger. The name at this stage stands as *Chalcis cuvieri* (Fitzinger). *Chalcis,* of course, also was long since preoccupied.

We next hear of the lizard in the long and careful description of Duméril and Bibron (Erp. Gén., Vol. V, 1839: 453). Here it is stated

that the species is South American and that *specimens* from "Colombie" are in the Paris collection. The Burts mistranslated this into the singular, making it appear that there was but *one* specimen in the Paris Museum. This they considered the type.

On writing my friendly colleague Monsieur Angel I learned that there are three specimens in the Paris National Collection which were in the hands of Duméril and Bibron. All these I have now seen. They are No. 2836, said to be from Brazil, collection of Thomas Bell; No. 2837, from the Orinoco, Prévost collection; and No. 7051, from "South America." These represent three distinct species. No. 2836 agrees insofar as a contact of prefrontals goes with my *S. alleni* but the agreement is far from perfect in other characters. To be sure the species may be variable but there are also two Thomas Bell specimens in the British Museum listed by Boulenger (Cat. Liz. B. M., Vol. II, 1885: 416) as coming from the West Indies (?), and it is probable that the Bell specimen in Paris is from this lot and the locality Brazil may simply represent a surmise. No. 2837 represents *S. trinitatis,* thus extending the range of this species to the mainland, but this is not surprising since Trinidad is essentially an island of the Orinoco delta. No. 7051 represents *S. pallidiceps.* It is too well known to require reiteration that locality was a matter of little moment to systematists until long after the time of Duméril and Bibron and their "Colombie" was used as a general term for northern South America. Colombia never, of course, extended to the Orinoco as we now use the name but New Grenada was, in Duméril and Bibron's time, the name for the present Republic of Colombia and "Colombie" or Colombia was, as I have said, used as a general term to include the area freed by the efforts of Bolivar and his associates and comprising what is now Venezuela, Colombia, Panama, Ecuador, Peru and Bolivia.

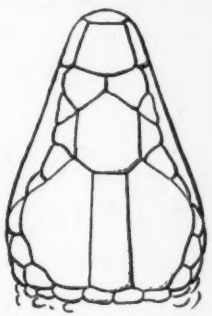

Fig. 1.—Paris Mus. 2836. "Brazil" Thos. Bell coll.

By the kindness of Mr. H. W. Parker I have been able to examine the two Bell specimens in the British Museum. How they came into Bell's possession I do not know—apparently his only connection with South America was his working up of the reptiles collected by Darwin while on the Beagle, and Darwin took no Scolecosauri.

These two specimens in the London Museum themselves prove to represent two species. One (B. M. vi. a. b.) is very similar to Paris Mus. No. 2836 and may be considered as representing, with it, the true *S. cuvieri* of which the geographical range is as yet uncertain. The second specimen (B. M. vi. 3. b.) almost certainly represents S. *trinitatis.*

Mr. and Mrs. Burt hold that on account of certain points of agreement in Duméril and Bibron's description with certain characters of Scolecosauri from the Island of Grenada that the name *S. cuvieri* should replace my *S. alleni* described from that Island. They recognize as valid *S. trinitatis* which I described from Trinidad and *S. pallidiceps* Cope from Colombia. They, however, did not know that all three species were repre-

sented among Duméril and Bibron's specimens although these authors themselves specifically stated that they had several specimens in hand. Their whole discussion is based on a description which is not the original description and is irrelevant. For Paris No. 2836 from "Brazil" does have the prefrontals in contact to be sure and Duméril and Bibron's reference to this fact has led Mr. and Mrs. Burt to assign the whole species to the Island of Grenada and thus make *S. alleni* Barbour a synonym of *S. cuvieri.* But here again they failed to observe that Duméril and Bibron expressly state that the prefrontals are *sometimes* in contact; thus

Scolecosaurus

Locality	Museum No.	Head and body	Tail	Total length	Head only	Head into head and body	Head into total length	Scales	Supra-oculars	Supra-ciliaries	Digits Front	Digits Hind
Brazil (Bell)	Paris 2836[1]	39	76	115	6	6.5	19.1	—	3	3	4	4
Orinoco (Prévost)	Paris 2837[2]	48	48	96	7	6.8	13.7	28(29)	3	3	4	4
Amer. Merid.	Paris 7051[3]	55	118	173	6.5	8.4	26.6	24	2	2	4	3
W. Indies (Bell)	B.M. vi. a.b.[4]	48	72	120	6.5	7.3	18.4	28	3 (or 4)	3	4	4
? loc.	B.M. vi. 3. b.[5]	40	M	?	6.5	6.1	?	29	3 (or 4)	4	4	4
Cannouan Isl.	M.C.Z. 32345[6] Type	49	87	137	7	7	19.3	28	3 (or 4)	3	4	4
St. George, Grenada	M.C.Z. 7793[6] Type	54	100	154	8.5	6.3	18.1	30	3 (or 4)	3	4	4
St. George, Grenada	M.C.Z. 7793[6] Paratype	43	77	120	6.5	6.6	18.4	31	3 (or 4)	3	4	4
St. George, Grenada	M.C.Z. 7793[6] Paratype	55	41	96	7.5	7.3	12.8	31	3 (or 4)	3	4	4
Grand Etang, Grenada	M.C.Z. 9005[6]	55.5	46	101.5	8.5	16.5	11.9	31	3 (or 4)	3	4	4
Grand Etang, Grenada	M.C.Z. 9006[6]	51	70	121	8	6.3	15.1	30	3 (or 4)	3	4	4
Grand Etang, Grenada	M.C.Z. 9009[6]	31	46	77	6	5.1	12.8	30	3 (or 4)	3	4	4

The series of *S. trinitatis* in M.C.Z. numbers 13 individuals.

indicating that their species was composite. An examination of Paris Mus. 2836 shows that it has only a vestige (a tiny round knob), of a fourth toe on the hind foot as well as having larger prefrontals with a narrower suture (see Fig. 1) than have specimens of *S. alleni.* Mr. and Mrs. Burt's surmise is the less probable also since so far as I can learn there are no other contemporary specimens of any sort in the Paris Museum from the Island of Grenada.

The list of species will then continue to stand as follows:

Scolecosaurus cuvieri (Fitzinger) [not of D. & B. as in Burt], distribution uncertain, but best considered represented by Thomas Bell's specimen in Paris Mus. No. 2836 until the original specimen of Fitzinger may perhaps be found or until new identical material is collected.

Scolecosaurus trinitatis Barbour, Trinidad, and probably the lower Orinoco Valley (Paris No. 2837).

Scolecosaurus alleni alleni (Barbour), Grenada.

Scolecosaurus alleni parviceps Barbour, Cannouan, see below.

Scolecosaurus pallidiceps Cope. Colombia.

[1] Prefrontals in contact, may be considered *S. cuvieri.*
[2] Agrees perfectly with *S. trinitatis.*
[3] Prefrontals widely separated (= *pallidiceps* but not very typical).
[4] Prefrontals in contact, separating frontal from frontonasal. Also to be considered *S. cuvieri.*
[5] Prefrontals separated very slightly by frontal in contact with frontonasal. Identity uncertain until more material with good data has come to hand: probably *trinitatis.*
[6] Prefrontals in wide contact, with frontal and frontonasal separated.

This arrangement does not upset anything which is positively known, and it is trite to say that the "first reviser" must base his revision on the original, not any subsequent description.

Scolecosaurus alleni **parviceps,** subsp. nov.

Type.—Mus. Comp. Zool. 32,345 Cannouan, The Grenadine Islands, B. W. I., taken by Doctor David Fairchild and H. F. Loomis, February 6, 1932.

Similar to *S. a. alleni* of Grenada but with smaller head and body shorter in proportion to the total length.

In conclusion I want to thank my colleague Mr. Arthur Loveridge for constant assistance and advice.

MUSEUM OF COMPARATIVE ZOOLOGY, CAMBRIDGE, MASSACHUSETTS.

Collecting at Helotes, Bexar County, Texas[1]

By JOHN K. STRECKER

TO a naturalist, there is always something fascinating about a visit to the type locality of an interesting species of animal. On the banks of Helotes Creek, twenty-two miles northwest of San Antonio, is located the old stone Marnock homestead, where, for more than forty years, abode Gabriel Marnock, pioneer Texas herpetologist. Marnock settled in what was at that time almost virgin territory and he found himself surrounded by numerous species of amphibians and reptiles of great interest, many of them of considerable rarity. Here, within a stone's throw of his home, he discovered the type specimens of the frogs described by Cope under the names of *Lithodytes* (now *Eleutherodactylus*) *latrans* and *Syrrhophus marnockii,* the skink *Eumeces brevilineatus* Cope, the little variegated gecko many years later named *Coleonyx brevis* by Dr. Stejneger, and a variety of garter snake named by Cope *Eutaenia cyrtopsis ocellata.* The garter snake has long since lost its distinctive name, *ocellata* now being regarded as a synonym of *Thamnophis eques* (Reuss), but the other four have maintained their validity through the years.

It has always been one of the writer's ambitions to study the fauna of the Helotes neighborhood at first hand. Many years ago, when the Marnock collection was purchased from Mrs. Marnock, he twice visited the Marnock home, on the first occasion to inspect the collection, on the second to pack it for temporary transfer to the rooms of the Scientific Society at San Antonio. Both times several hours were devoted to an inspection of the physical features of the locality, particularly the banks of Helotes Creek where a few specimens were collected; but it was not until 1931 that he was enabled to investigate the hill at the rear of the house, where the original types of Marnock were first discovered.

[1] This paper was found among the unpublished articles of Mr. Strecker after his death. At my request, Mrs. Strecker has permitted me to submit it for publication.
April 8, 1933 Walter J. Williams.

I am indebted to Mr. Charles H. Gable of San Antonio, a teacher of nature study whose life is wrapped up in his work, for making my two visits possible. Early on the morning of April 19, 1931, our little party, composed of Mr. Gable and his son, Hugh, Mr. H. B. Parks, secretary of the Texas Academy of Science, and I, arrived at the old Marnock place which is now occupied by a Mr. Kelly and his family. Mr. Kelly kindly gave us permission to roam at will and collect to our heart's content. Later in the year, in early November, in company with Mr. Gable and Hugh, I again visited the place. The two days spent in the locality netted me 35 specimens of amphibians and reptiles, many scorpions and centipedes, and hundreds of snails. The herpetological material included specimens of Marnock's types with the exception of *Eumeces brevilineatus* which I had previously obtained on the rocky banks of Helotes Creek.

Fifteen specimens of *Coleonyx brevis* were found in hiding under small flat rocks. In no instance was more than one found under the same rock and no two specimens were found near one another. The peculiar mouse-like squeak of this species is quite characteristic of small geckos. The single *Syrrhophus marnockii* was also found under a rock similar to those which housed the geckos. It was discovered early in the morning before it had thrown off the lethargy occasioned by the coolness of the preceding night and made no effort to get away but hugged the ground closely as though attempting to escape our observation by counterfeiting the appearance of its surroundings, which were not very different in color to the animal.

One *Eleutherodactylus latrans,* a junior 16 mm. in length of head and body, was also found under a stone. The date of its capture and the size of the animal suggest that, even in the Helotes neighborhood, this species may not always be a winter breeder as was suggested to Cope by Marnock. This specimen is peculiarly marked. It has a broad white band across the lower back, a white band across each arm, and a white spot on each eyelid. Across the back of the head is a well defined Greek cross also white in color. A somewhat similar specimen, but larger and not so conspicuously marked, is in the Baylor University collection. This specimen will, I believe, be described in detail by Dr. Albert Hazen Wright in his forthcoming book on the frogs of North America. All of the other young specimens of this frog which have been examined by me, were marked essentially like adults.

The garter snake, *Thamnophis eques* (Reuss), was a brilliantly colored adult with the body blotches large and distinct and with very conspicuous nuchal patches. It was discovered in a hole among rocks on the side of the dry hill at least a quarter of a mile from water.

Other specimens collected at Helotes were three of *Sceloporus torquatus poinsettii* Baird and Girard, two of which were large male examples, all found under rocks; three of *Sceloporus undulatus thayerii* Baird and Girard, one male of *Sceloporus variabilis* Wiegmann, three of *Holbrookia texana* Troschel, two of *Crotaphytus collaris* Say (both having two rows of interorbital scales!), one *Tantilla gracilis* Baird and Girard, and one *Elaphe laeta* Baird and Girard.

All of the above specimens were captured alive. Had we been provided with a collecting pistol, we might have collected many more specimens of the two small species of *Sceloporus* and *Holbrookia texana.*

The Marnock hill is very rocky and in many places is covered by growths of cedar, scrubby deciduous trees and shrubs, opuntias, and other flora. A number of goats get most of their subsistence on its slopes and summit and it is surprising that it is still inhabited by so many species of small native animals. In the sheep regions in western Texas, the wooly grazers have destroyed much of the smaller fauna through retarding the growth of vegetation, and killing snails and reptiles with their hoofs.

Along Helotes Creek, I have at different times collected or noticed specimens of *Eumeces brevilineatus* Cope, *Sceloporus spinosus floridanus* Baird, *Leiolepisma laterale* Say, *Cnemidophorus sexlineatus gularis* Baird and Girard, *Natrix sipedon transversa* Hallowell, *Natrix rhombifera* Hallowell, *Storeria dekayi* Holbrook, *Thamnophis proximus* Say, *Pseudacris ornata* Holbrook, *Acris gryllus* Le Conte, *Rana catesbeiana* Shaw, *R. pipiens* Schreber, at least two large species of *Bufo,* and other species which I do not now recall. Water turtles are numerous in the creek.

Considering the nearness of the large and populous city of San Antonio, the fauna of the Helotes neighborhood, as regards number of species, seems singularly undisturbed by the flight of the past forty years.

Baylor University, Waco, Texas.

Absence of One Eye in a Frog

By Charles E. Johnson

In a lot of live frogs recently received for laboratory purposes there was found a male specimen of *Rana pipiens* in which the left eye was absent. Examination indicated that this was a congenital condition, and I became interested to see what further anomalies might be found correlated with the failure of the eyeball to develop, especially with reference to the eye muscles, the fate or disposition of which was not predictable on the same basis as one might predict certain deficiencies to appear in connection with the nervous system.

This anomaly appears to be—at least so far as my own experience goes—of rare occurrence, for although I have, throughout a period of many years, examined thousands of frogs, this is the first instance of its kind that has come to my attention, directly or indirectly. I am indebted to one of our laboratory assistants, Mr. Dean Mather, for the present specimen.

Examination and dissection of the specimen revealed the following conditions. The skin covering the orbital space was somewhat depressed, but presented a smooth appearance except for a slight indication of a longitudinal groove or fold. Underneath the skin was a fibro-cartilaginous membrane extending across the orbital space, constituting what I have referred to below as the orbital fascia. Optic foramen, optic nerve and right optic tract were lacking. The right optic lobe was conspicuously reduced,

being approximately only about two-thirds the size of the left lobe.

The eye muscles presented an interesting condition, only two of them being, it may be said,—without having had recourse to a study of the nerve supply—readily recognizable individually. Of the remainder the majority are not separately recognizable with certainty, but they are evidently represented in modified form in bands of muscle tissue which take origin at points approximating the origins of the respective eye muscles in the normal condition, as the following description will indicate.

M. rectus superior: At a point corresponding to the origin of its fellow of the opposite side is a short but well differentiated muscle directed antero-ventrally on the lateral surface of the cranium, its fibers joining another muscle band arising from the area of origin of the oblique muscles later to be mentioned.

M. rectus inferior: This is evidently represented by another small muscle which is attached to the orbital fascia, on the one hand, and, tapering into two tendinous slips, attaches on the other hand to a muscle band originating at a point corresponding approximately to the origin of the normal M. rectus lateralis (externus).

Mm. obliquus superior and obliquus inferior: These are not readily identifiable; but in the angle between the palatine and the ethmoid, from an area approximating that of the origin of the normal oblique muscles, arise two relatively long, contiguous bands of muscle. The lateral one of these extends postero-laterally and inserts in the orbital fascia; the medial band at about midway in the orbital space turns postero-ventrally, following the surface of the cranium, and becomes attached somewhat dorsad of the area of origin of the normal lateral rectus and its associated muscles, that is, at the side of the cranium in the angle formed by the parasphenoid and its lateral process.

The lateral one of these two bands probably represents the M. obliquus superior; the medial one, the M. obliquus inferior—in whole or in part, for it is possible that the posterior part of this muscle represents the M. rectus medialis (internus) which has grown forward from its point of origin and has joined its fibers with those of the obliquus inferior.

The Mm. rectus lateralis, rectus medialis and the retractor bulbi are even less positively recognizable. Within the normal area of origin of this group arises a somewhat cylindrical muscle which extends antero-dorsally to become attached to the orbital fascia. Accompanying this muscle and mingling its fibers with it distally is a smaller muscle with origin slightly dorsal to that of the first mentioned. Possibly these two represent, respectively, the lateral rectus and the retractor bulbi.

M. levator bulbi: This is the largest of the modified eye muscles and its identity seems clear. It arises from the posterior border of the orbital space, passes ventrad of the muscle bands arising from the area of origin of the obliques, and then turns dorsally along the surface of the ethmoid to insert at the antero-medial border of the orbital space. It is much reduced as compared with the normal levator bulbi and its course is such as to suspend as if in a sling the muscle bands representing the obliques.

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A Study of the Variation of the Dorsal Scale Rows of *Charina bottae* (Blainville)[1]

By Vasco M. Tanner

In 1890 Dr. Leonhard Stejneger made a careful study of the genera and species of boids of the western United States and at that time synonymized *Wenona* Baird and Girard and *Psudoeryx* Jan with the genus *Charina*. He recognized *Charina bottae* (Blainville), *C. plumbea* (Baird and Girard) and *C. brachyops* Cope as species, placing *Wenona isabella* Baird and Girard as a synonym of *C. plumbea*.

In 1900 Cope considered all the rubber-snakes from the Pacific coast as *C. bottae*, except one specimen from Point Reyes, California, which he believed "stands quite outside the wide range of variation of *C. bottae*, presenting characters which might be and have been considered to be of generic importance." This specimen he retained as *C. brachyops*.

Dr. John Van Denburgh, in 1920, proposed the name *Charina bottae utahensis* for the rubber-snakes collected in Utah in 1913 by Joseph Slevin. The type, from Little Cottonwood Canyon, Wasatch Mountains, Wasatch County, Utah; four specimens from Provo Canyon, two from Fort Douglas and two from Idaho, were said to differ from the Pacific coast form, *Charina bottae bottae*, by having 41 dorsal scale rows.

In 1923 Stejneger and Barbour listed all the above mentioned species, as well as *C. b. utahensis* Van Denburgh, as synonyms of *C. bottae*, thus considering all the western American forms as one species.

In 1926 Dr. Alexander G. Ruthven presented a concise summary of his findings as to the status of *C. b. utahensis*, and concluded by saying: "The recognition of the Utah specimens as a subspecies should probably be deferred until other distinctive characters are found. Geographic variation in the number of dorsal scale rows in snakes is of rather common occurrence, and, unless distinctly discontinuous, or accompanied by other differences, cannot well be used as subspecific character."

Since the above point of view expressed by Stejneger and Barbour (1923) and Ruthven (1926) has been ignored by Pack (1930) and Woodbury (1931), the writer decided to study as many specimens of rubber-snakes as could be obtained and to determine, if possible, the extent of variation of the dorsal scale rows. A study was also made of the scutellation of the head, the number of gastrosteges, urosteges, total body length, length of head and body, length of tail, sex, etc., to determine to what extent geographical groups were noticeably different morphologically.

One hundred and fourteen specimens from eight western states have been studied by the writer, and information concerning six others have been taken from the writings of Ruthven (1926), Ortenburger (1921), and Van Denburgh (1920), making a total of one hundred and twenty specimens reported on in this study. This was the only material available, since the rubber-snake is not common, and none of the educational institutions or museums have a large series of this species.

[1] Contribution from the Zoological Laboratory of Brigham Young University, Provo, Utah, No. 46.

The writer is indebted to the following who kindly loaned or sent information called for concerning their specimens: United States National Museum for the loan of 41 specimens; California Academy of Sciences for the privilege of studying the specimens contained in their collection, especially the type of *utahensis*, and for information concerning 28 specimens; University of California Museum of Vertebrate Zoology for the loan of 20 specimens; Mr. L. M. Klauber, of the San Diego Natural History Museum, for the scale counts on the two specimens in that collection; Dr. F. N. Blanchard, University of Michigan, for the scale count on two specimens from Twin Bridges, Montana; Professor W. W. Henderson, Utah State Agricultural College, for the loan of seven specimens; Professor A. M. Woodbury, University of Utah, for the scale count on the only specimen in the University collection; Mr. D. G. Yeager, Park Naturalist (1930) Yellowstone National Park, for the loan of one specimen taken in the Park. Twelve specimens are in the Brigham Young University Collection, one from Quincy, California, one from Paris, Idaho, and ten from Provo Canyon and Mount Timpanogos, Utah.

The following table and discussion presents the information gathered as to the dorsal scale row variation of the 120 specimens. The findings

TABLE I

DORSAL SCALE ROW OF 120 SPECIMENS OF *CHARINA BOTTAE*

States	*Dorsal Scale Rows*														
	38	39	40	41	42	43	44	45	46	47	48	49	50	Tot.	Avg.
California			3	5	2	10	5	7	3	7	2	3		47	44.38
Idaho		1	2	1		3								7	41.28
Montana					2	2	1							5	42.80
Nevada				1		1				1				3	43.66
Oregon				4	1			2	1	1		1		10	43.80
Utah			5	12	4	5								26	41.34
Washington				3	7	3		1	1					15	42.46
Wyoming										1				1	47.00
Specimens reported but not seen by writer															
Idaho				2										2	41.00
Utah					1	1		1						3	43.33
Wyoming						1								1	43.00
Total	0	1	10	28	17	26	6	11	5	10	2	4	0	120	43.08
Odd and even Scale groups	38–39		40–41		42–43		44–45		46–47		48–49				
Total	1		38		43		17		15		6			120	43.48

concerning other morphological differences will not be presented in this paper. These differences are, however, so slight that it is practically impossible to separate a series of specimens from widely different localities by the scutellation of the head, gastrosteges, etc.

Care was exercised in making the scale count to get the maximum number of rows by counting at the middle of the body since it was found

that there were more scale rows at this point than just back of the head or anterior to the anus. While one-third of the specimens examined have an even number of scale rows, it has been pointed out by Ruthven (1908), and Blanchard (1921), that normally there is an odd number of rows. If the average or arithmetical mean for the 120 snakes in question is computed by using the groups from 39 to 49 it is found to be 43.08 dorsal scale rows; if the even row groups are added to the odd groups, from which they have evidently departed, the average is then 43.41 dorsal scale rows. Also by adding the even and odd groups as in Table No. I, a smooth polygon is produced, whereas if this is not done an uneven one results. It may also be seen from the table that the average for the 47 California specimens is 44.38 rows while for the 26 Utah specimens it is 41.34 rows, a difference of about three rows. In just which direction from the average the variations are evolving, in the establishment of a more or less discontinuous group, is not clear from this study. However, it appears that the Pacific Coast specimens are trending towards more scale rows while the interior (Utah) specimens are developing fewer rows of scales. It was impossible in this study to find a correlation between the number of scale rows and the size or sex.

Van Denburgh and Slevin (1919) found that *Pituophis,* the gopher-snake, has a wide variation in the number of gastrosteges, the Pacific coast specimens having fewer, ranging from 200 to 220, while the desert and interior (Utah, Arizona, and Nevada) specimens varied from 230 to 263 rows. Thus the variation is the reverse of that of the dorsal scales of the rubber-snakes. Just how the environment effects changes of this kind, and toward what end they are directed, is not known. The dwarfing of the body may explain some variations but not others.

In conclusion it seems that the evidence at present supports the contention that the rubber-snakes from the western states should be considered as one species, *Charina bottae,* also that the Utah specimens are not sufficiently distinct from other specimens taken throughout the eight western states to warrant their recognition as a subspecies at this time.

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Mating of the Prairie Rattlesnake, *Crotalus confluentus confluentus* Say

By FLORENCE DOWDEN WOOD

SURPRISINGLY few observations have been recorded on the mating habits of snakes in general, or of rattlesnakes in particular. Isolated instances have been reported a score or more of years apart, of which the chief datum is the time of mating. Matings of *Crotalus* are reported in the literature as occurring from April to August, each author drawing the sweeping conclusion that the mating season is on the specific date on which he observed it. The localities from which matings have been reported range from the Mojave Desert to the Columbia River Valley, and from low to high altitudes. A compilation of these observations fails to fix a definite spring or fall mating season, neither do the mating times vary with latitude, nor with a physiological cycle.

So far as I am aware, all the reports in the literature point to diurnal matings, with two exceptions. The first of these is by Geyer (1847). While exploring the Columbia River Valley, he camped on the banks of the Spokane River, at the foot of a high peak on August 22. About 10 P.M. he was drawn away from a roaring fire by the evident alarm of his mule, and by a great rustling on the stream bank. On nearing the river, he beheld by the brilliant moonlight literally hundreds of *Crotalus horridus (sic)* weaving around and across each other at a great pace, emitting an unbearable stench and beating their rattles on the granite rock. The author made a hasty retreat and later inferred, from the subsidence of the noise and the composure of the mule, that this strange mating revel had ceased around midnight. A search in the morning failed to reveal a trace of a single snake, except the corpse of one killed the day before. Some time later, Head Factor MacDonald of Fort Colville confided somewhat reluctantly that he, too, had seen such a sight on August 21. In the same paper, Geyer reports a female *C. horridus* in this region, guarding 40 of her eggs, some of which had just hatched. The eggs were the size of the smallest dove eggs, round or nearly so, and white. Two things are obvious in the foregoing. First, the snake in question, if a rattler, is certainly not *C. horridus*. Second, the eggs do not fit the description of the ovo-viviparous "eggs" of any known crotalid, either in form, size or number. Given the above erroneous impressions, are not doubts legitimate regarding the midnight orgy?

With respect to the second nocturnal mating in *Crotalus*, Merriam (1893) reported single pair matings of *C. cerastes* during the day in Death Valley. Some of these pairs remained in embrace during the night. By

morning they had been so thoroughly stupefied by cold that they were unable to move. This chilling would be the rule for snakes in northern latitudes or high altitudes. The activity of a snake is so dependent on surrounding temperature that there are few places in the upland plains north of 41°, even in mid-summer, where the temperature after sundown would not cool the most ambitious reptile. This applies doubly to mountainous regions (i.e., Ft. Colville, 48° 30′ N.) where there is a nightly drop to near freezing, even in summer. A snake in the latitude of Ft. Colville would spend the night under a rock that had been heated by the sun. It is conceivable that snakes thus warmed would mate during the night. It is hardly credible that aggregations of hundreds of rattlers should exhibit seething activity on the banks of a rushing snow-fed stream at a time when the temperature was nearing its daily minimum.

The author wishes to express appreciation to Dr. G. K. Noble and to Mr. C. H. Pope for interest and criticism in the preparation of this paper.

Some early expeditions reported 1800 to 2000 rattlesnakes per season. During three season's collecting in various fossil fields of the western United States, I visited many localities alleged to abound in rattlesnakes, and although collecting generally involved entering ideal rattlesnake territory, only about two dozen rattlers were seen.

The writer was fortunate enough to see two pairs of courting snakes while on a paleontological collecting trip in the Wind River Basin, Wyoming, seven miles northeast of Lost Cabin, on the north side of Alkali Creek, near the Fremont—Natrona County border. On August 2, 1931, a rattler was surprised on a rock shelf, above a deep draw leading down to Alkali Creek. The snake, a large one, escaped under the overhanging sandstone. Three days later, Dr. H. E. Wood and I found the snake under the same ledge. Almost as soon as the snake was clearly visible, at about 40 feet, he rattled. Several blows with stones failed to stun him, and he hid under the ledge, after which he was hooked out with a paleontologist's pick. As the snake was thus forcibly uncoiled, what had seemed to be one voluminous snake, turned out to be two mating snakes closely intertwined. The smaller female was quickly despatched without resistance. The more elusive male had to be held down with a pick, at this time showing the first inclination to fight. He struck at me several times as I moved about, ignoring his captor who was closer. A rock of considerable size was thrown at the snake's head, which he struck in mid-air, meeting it on the snout. The blow stunned him, but by the time a second stone was thrown, he had recovered and met it in the same way.

Both snakes were examined after death. The male, closely approaching a moult, was slightly over five feet long, apparently the record for *C. confluentus confluentus*. He was slender for a rattlesnake of that length. The cloaca was much distended, partly everted, and actively secreting mucous. The female, about 30 inches long, bore no external evidence of sexual excitement. She contained eleven well developed embryos, eight inches long, with yolk unabsorbed about the size of that in a hen's egg. The embryos, on exposure to the air, quickened and made breathing motions. Intake of air was prevented by a thin membranous diaphragm

which bowed in and out as the animal gasped with wide open jaws. This membrane is doubtless homologous with the occlusion membrane in copperhead, moccasin and alligator embryos, described by Reese (1926).

On August 9, while climbing along the wall of an adjoining draw, I heard discontinuous rattling, as if a snake were dragging its tail on the ground or through grass. I approached and saw two courting snakes, *C. confluentus confluentus,* the longer and thicker female crawling along the ground, and the smaller male, newly moulted, weaving along over her back. The noise of my climbing aroused the male and after a glimpse of me, he darted at me without pause, covering the eight or ten feet down the steep slope so rapidly and so unexpectedly that there was barely time for me to leap aside. His momentum carried him several feet farther down before he turned around. The female had moved only a few feet away from where the male left her, showing no excitement. After climbing above the snakes, I threw a stone in their direction, and as they were close enough together by this time to be disturbed by this poorly aimed rock, both rattled for the first time. The hill was steep and the footing in the loose clay mantle was too insecure to combine safety and further curiosity, in view of the male's uncertain temperament and the absence of any weapon. In the author's experience with snakes of any kind, this male *Crotalus* was the only one to show real aggressiveness as opposed to the usual efforts to escape. It might be assumed that the animal was overwhelmingly curious, but it seems probable that curiosity would have been manifested in cautious movements rather than an accurately aimed lunge at an intruder.

Less than a week later a female of the same species was taken further north in northeast Park County, whose seven embryos were indistinguishable in size from those taken from the mating female. From this, fertilization appears to be nearly synchronous in these two localities. Further south, in Duchesne County, Utah, during the first week in August, 1928, a young prairie rattler was caught which had already passed its first moult. This may mean that fertilization occurs earlier in this region; or that there is a slight seasonal variation from year to year; or that individual cases may fluctuate over some weeks.

Considering the available data, mating or mating overtures appear to be sporadic throughout the summer, although ovoposition is fairly constant. With the exception of Geyer's account, mating in *Crotalus* has been observed to occur in single pairs. In contrast to this, Audobon (*fide* Brehm) reported a tight ball of thirty to forty mating vipers, *Vipera berus.* "E. L." reported a ball of *Eutaenia sirtalis,* and another of *Bascanion constrictor,* each of "several hundreds", united together for procreative purposes. Both mention that the sight was so terrifying as to provoke immediate flight from the scene, which hints at incomplete observation. J. J. Burke, of the Carnegie Museum, Pittsburgh, has seen single pairs of mating blacksnakes wound into a large ball, which on casual observation might have appeared as many snakes (verbal communication). Blanchard (1931), in a study of the males of a number of smooth scaled snakes, correlated certain ridges on the scales of the chin and anal region

with their mating habits. These ridges are brought into play in courting and their use depends on the assumption of a definite pose by two snakes, which is well illustrated in Blanchard's photograph of mating wild garter snakes. These adaptations are secondary sex characters conditioned upon single pair matings. Evidence for single pair matings in exotic forms is not lacking, since Boulenger (1913) makes no reference to other possibilities in habits. Poyntz (1927) cites an instance of sea snakes taken in coitu from the Persian Gulf. The unusual feature of this is the fact that these marine snakes mate in the water, unlike our freshwater watersnakes and moccasins which are reported to court and mate on land.

Snakes observed mating in captivity [Effeldt (*fide* Brehm), *Ancistrodon piscivorous;* Wiley, *Crotalus atrox;* Meade, *Ophibolus getulus sayi*] are known to have mated in single pairs where more than two snakes were housed together. It should give survival value for an animal possessing internal fertilization to mate efficiently, and not promiscuously in hampering aggregations. An instinct among snakes to procreate in large numbers seems improbable in animals whose physiological and anatomical development is well above the amphibian level.

The following direct inferences can be drawn from the observations made in the field:

1. *Crotalus confluentus confluentus* has been seen courting and mating in the first week of August in central Wyoming.
2. Mating occurred in the heat of the day.
3. Mating, as observed, is in single pairs.
4. Pregnant females will mate.
5. The male, during courtship, may attack an intruder.

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Field Notes on Some Amphibians from British Guiana

By Stanton C. Crawford and Edgar P. Jones

THESE observations on certain amphibian species were made in British Guiana incidental to the collection of herpetological material for histological studies.

1. *Bufo marinus* (Linnaeus)

These very common toads appear as dusk approaches. On rainy nights they make considerable noise flopping on the wet ground. Individuals are frequently well over a pound in weight, and are hence the largest amphibians of the country. The volume of the voice is exceeded only by that of *Hyla maxima.*

Above, the color is a rich brown touched with brighter tones, while large dark spots make a pattern. Young specimens are very variable, but tend to show a darker ground color than the adults. Specimens preserved included one from Matope, one from Amatuk, one from Upper Camaria and 52 from the Kartabo region. Many others were seen, especially in Georgetown, where they gather in the evenings under the street lamps to catch insects.

2. *Bufo typhonius* (Linnaeus)

The angular configuration of the head along with the darkly variegated dorsal coloration make this animal very inconspicuous when it is among fallen leaves. Hence it is commoner than is realized. Its movements seem comparatively awkward and feeble.

Ridges on the head are strongly elevated, and in the adults are very prominent and bony. Above, the general color is some tone of olive or brown, usually dark, with a few darker brown or black spots or bands. Sometimes there is a light vertebral line. Beneath, the general coloration is white, mottled with buff or brown, these darker patches tending to become continuous anteriorly. Twelve specimens, all from the vicinity of Kartabo, were preserved.

3. *Bufo guttatus* Schneider

There is a colony of these animals at Matope under and about the government shelter house erected there. Only two specimens were collected. Others were seen but these were left undisturbed so that there would be no risk of weakening the colony, which is certainly a rare one in British Guiana.

The coloration is brown above, without pronounced markings. Beneath, the smooth skin is diffused grayish, brownish or blackish in color, marked with round light dots. These toads sit rather erectly, and their spotted "vests" present a distinctive appearance.

4. *Leptodactylus pentadactylus* (Laurenti)

A very large specimen was found sitting in the lee of a mangrove root on a mud flat. A small one was accidentally picked up with dead bamboo leaves used to cover the floor of an animal cage.

The animals are brownish above, generally with dark spots arranged in transverse bars. A black stripe runs along canthus and temporal fold.

The limbs are cross-barred and the thighs are marbled behind with black and yellow. Five specimens, all from the Kartabo region.

5. *Leptodactylus mystacinus* (Burmeister)

Most of the specimens were taken about a carrion pile, where they were catching flies. These frogs were small and very quick in movement, after the habit of grasshoppers. When on the ground they took advantage of every irregularity in seeking concealment, hiding under leaves and in the angles against dead branches or stones.

Distinct pores, each surrounded by a whitish halo, occur on the upper surfaces of the legs, while the flanks show oval glands. The dorsal coloration is reddish brown to violet rose, with a deep brown or black streak on either side. There are other dark and light markings. A well-accentuated "moustache" is characteristic, and there is a whitish line between this and a blackish brown line on the upper lip. Spots and bars on the limbs are touched with rose. Beneath, there is a discoidal fold; the skin is white, but is spotted on the throat. Ten specimens, all from the Kartabo region.

6. *Leptodactylus mystaceus* (Spix)

A common form, of rather slender build, with generally smooth skin, and with a fine elevated mid-dorsal line running from snout to vent. The color varies from brown to olive-gray above, with darker markings, which tend to be tinged with white posteriorly. A light-edged dark band lies between the eyes. The broad dark "moustache" stripe on the canthus and running through eye to ear has a prominent white stripe beneath it, and beneath this, in turn, is a dark brown band on the upper lip. The limbs are cross-barred, with a characteristic longitudinal white stripe on the thighs, which are dark brown posteriorly. Beneath, there is a discoidal fold, and the skin is yellowish-white. The lower lip is edged with brown or green. Twenty specimens, all from the Kartabo region.

7. *Hyla maxima* (Laurenti)

These animals, the largest hylas in the country, also outdo other amphibians in the loudness of their voices, which have almost a mammalian quality. The specimens collected with one exception seemed rather delicate, dying in containers or in the vivaria to which they were transferred. One frog, of which a large portion of the head and the contained eyes was cut off and thrown into fixing fluid, furnished an interesting record. The body, thrown aside as dead in the evening, was quite active the next morning, and lived for eleven days. Apparently the knife had passed just in front of the medulla. The cut surface healed over nicely. The decraniated animal, its lower jaw and tongue alone remaining to mark the outline of the head, showed a perfect sense of equilibrium. It would crawl up on a rotating object so as to remain in normal position on top of it, and would jump normally except that bad landings were made. It made no effort to swallow flies, even when they crawled over the tongue, but would receive them when they were introduced into the oesophagus. Before death the body became strongly twisted to one side.

Above, the ground color is brown or reddish brown, variegated with lighter and darker. The limbs usually show dark crossbars. Sometimes there is a dark vertebral line from the tip of the snout to the sacrum. Beneath, the skin is a uniform light tan.

One frog when collected had a definite tan coloration above, with the vertebral line showing dark brown, black at the snout, and with brown "ribbing" along the sides. The next day the ground color became distinctly coppery. This frog ate some small toads that were sharing the vivarium.

Another specimen exhibited a rich copper tone when caught. Later it appeared more gray than brown. When so colored, close inspection revealed small spots of light green, very light tan, and a somewhat darker tan. Before death it began to change back to the copper hue, and died just as the shade was becoming distinct and the darker rib-like stripes were becoming evident on the sides. After preservation, close inspection revealed small spots of light and dark brown, but no green. Eleven specimens were preserved, two from Matope, the rest from Kartabo.

8. *Hyla granosa* Boulenger

All specimens were captured at night in a swamp upon broad green leaves. The call is a medium-pitched "pink". The eyes are very prominent. This impression is probably accentuated by the pale and fragile appearance of the animal.

These animals are almost colorless, but are faintly green above, with minute yellow and purplish white spots scattered irregularly. The upper eyelid is rose, while the legs and snout are touched with light brown. On the legs the brown increases in intensity as it approaches the phalanges, due to the increasing concentration of tiny brown spots. Beneath, the color is a pale green, shading off to white. Three specimens, all from near Kartabo.

9. *Hyla boans* Daudin

General habit slender, with a pointed nose. The ground color is quite variable from time to time in the same animal, ranging from very light tan through russet to dark brown. There are irregular cross bands of darker brown on body and limbs. A dark brown line, almost black at times, runs through nostril and eye to a point above the arm. A white line above the anus is conspicuous.

Animals in the light phase of color hardly showed the darker pattern, except over the shoulders. Upon assuming the darker phase the pattern also became more distinct, except that if the ground color became very dark, the pattern naturally was less conspicuous through lack of contrast. The skin beneath the body is white, somewhat tinged with yellow. In one specimen this shaded into dark tan on the throat, towards the vent and under the limbs. One specimen was brought from the Penal Settlement and five were picked up at Kartabo.

10. *Hyla marmorata* (Laurenti)

All specimens were caught at night on the green leaves about five feet from the ground, by use of a light. The call is of medium pitch. These

specimens, as reported in earlier papers,[1] afforded the first record of the occurrence in British Guiana of this Ecuadorean species.

The color is reddish brown above, marbled with dark brown. The limbs are cross-barred. Beneath, these animals are bright saffron, with small round black dots. The extremities are sooty black. The somewhat voluminous webs are black and saffron. These bright colors appear in striking contrast. Four specimens were preserved.

11. *Hyla rubra* Daudin

This is the most common hyla of British Guiana. The call is a "quack-quack", quite deep in tone but not of great volume. One frog was collected in the tube formed by a large rolled leaf; another one on a stem. Both of these locations were about two feet above the ground. Several frogs were taken in the bungalow. These animals were seemingly attracted to lights, both of the house and of the electric torch.

The general effect is dark green, or even brownish. Characteristically there is a dark X-shaped figure covering the back. This figure is formed by two dorsal bands, which approach each other and sometimes fuse about the middle of their range. Each side of the body also shows a dark streak, terminating in front of the hind leg. Above, the general ground color ranges from light green to olive. The darker markings range in intensity from time to time, from dark green to almost black. There is a band between the eyes.

The belly and under surfaces of the limbs are light yellow, with a bluish tinge, and the blood vessels show through. There are black bands on the legs, which also show white marbling in front and behind. Twenty specimens were preserved, one from the Penal Settlement, the rest from about Kartabo.

12. *Dendrobates trivittatus* (Spix)

These are small ground frogs, common but hard to catch. They are noisy, the high-pitched "pip-pip" being heard almost continuously throughout the day. This species lives in piles of twigs or among the fallen leaves of the jungle. When pursued, it dodges under a leaf and is not seen again for some minutes, when it reappears a few feet away.

The color is shiny black, with a whitish line, tinged with yellow and orange, on each side of the back and continuing forward on upper eyelid and canthus. Another such line, on the upper lip, extends to the arm. There are yellow-orange spots on the limbs and sometimes beneath the body. Four specimens were collected about Kartabo. One carried seven tadpoles on its back between the stripes.

13. *Rana palmipes* Spix

This frog is found along the shore, also deep in the jungle. Individuals hid under leaves when such cover was available, remaining still when the leaves were moved. Frogs of this species were seen and heard throughout the night.

[1] Crawford, Stanton C. Adaptations to Nocturnal Life Exhibited by Various Animals of British Guiana, with Special Reference to the Anatomical Basis of Night Vision in the Amphibia and Reptilia. *Univ. Pittsburgh Bull.*, 22 (31), 1926: 29-37.
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The ground color is olive or brown above, uniform or with small blackish spots. A dark green stripe runs from snout through eye to rear of body. Spots on the limbs are arranged in cross-bars. The sides of the body are medium brown below the green stripes. Beneath, the skin is yellowish white with small brownish spots and marblings. Two specimens from near Kartabo were preserved.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF PITTSBURGH, PITTSBURGH, PENNSYLVANIA, and UNIVERSITY OF AKRON, AKRON, OHIO.

A Preliminary List of the Amphibians of Lebanon County, Pennsylvania, with Notes on Habits and Life History[1]

By J. WENDELL BURGER

WITH the exception of a few records by Surface (1913), no reports have been submitted on the amphibians of Lebanon County, Pennsylvania. Hence, in order to fill a very slight gap, rather than for the unusualness of the specimens taken, I submit this preliminary list of amphibians based, with the exception of Surface's records, on my own collecting during 1930.

A few words as to the character of the county may be helpful in placing the animals found there. Through the center of the county the Lebanon Valley, a fertile farming land underlaid with limestone, extends from Berks County on the east to the Susquehanna River on the west. The valley drains into the Susquehanna through two branches of Swatara Creek, the larger now polluted by the anthracite coal fields on the north. Conewago Creek drains from the mountainous southern portion. At one time a canal ran through the valley from the Susquehanna. At the southern border of the county lie the South Mountains, a low ridge, and the northern part is filled with numerous ridges of the Blue Mountains. Several artificial lakes and dams exist. These and their creeks in the south-east form the water supply of Lebanon, the county seat, in the center of the valley. The county has been well populated since colonial days.

1. *Triturus viridescens viridescens* (Rafinesque)

Both the aquatic and terrestrial forms have been taken, the former in an overflow pool of Lake Conewago, Mt. Gretna, and the latter on a pine forest floor near Green Point. I could find no suitable pond or lake situated near this latter locality, and evidently the animal has to make rather a long migration when it returns to the water. Of course there is the chance that a nearby pool was overlooked.

2. *Gyrinophilus porphyriticus porphyriticus* (Green)

One medium sized specimen was taken on the summit of Blue Mountain, under a log deeply embedded in leaves in a turgid stream.

[1] Contributions from the Department of Biology, Haverford College, No. 7.

3. *Pseudotriton ruber ruber* (Sonnini)

This animal is especially numerous in the springs and mountain brooks of the South Mountains. In the latter part of March and the beginning of April, it is easily found under leaves, etc., often many feet from water, but at the same place in mid-summer, it is extremely difficult to find. In mid-summer one young adult was taken under moss in a drying bog, in a torpid condition, some distance from running water. Surface reports the species from Annville and Onset. It is a wide-spread form.

4. *Desmognathus fuscus fuscus* (Rafinesque)

This is by far the most common amphibian of the county, especially in the mountains in the north, where it occurs in every brook. The ventral coloration of some of the animals is a light yellow or green, of others dark, with the dorsal stripe almost obliterated. A cluster of eleven eggs was taken under some moss on a mountain slope the first week in September, as the larvae were just ready to emerge, and a few, owing to the excitement of being disturbed, did break through the egg membrane. On hatching the egg yolk is not totally absorbed, and causes a bulge in the belly. The female left the eggs when disturbed, although I have seen one remain with the larvae at Haverford, Pennsylvania.

5. *Eurycea longicauda* (Green)

Surface reports this animal from Myerstown and Scaefferstown. I have taken it in only one spot, the northern side of an old canal tunnel, under stones. It was abundant in this situation, but none of the animals was unusually large.

6. *Eurycea bislineata bislineata* (Green)

This form is wide-spread but not particularly numerous in any spot. It is most abundant in the low streams of the northern part of the county. The coloration is occasionally vivid. Surface reports it from Myerstown.

7. *Plethodon glutinosus* (Green)

As far as I was able to discover, this salamander occurs only in the northern mountain forests, preferably pine. It was not taken south of Green Point. None of the specimens collected in those woods were very large, and all had rather large spots.

8. *Plethodon cinereus* (Green)

This species is to be found everywhere, and is quite plentiful. At Mt. Gretna I saw one swimming about in a pond of water, obviously in no hurry to get out. One afternoon I found eight red-backed but none of the dark phase in a small area on South Mountain; this no doubt was accidental, and the dark phase probably could have been found there. Surface reports the species from Annville and Myerstown.

9. *Hemidactylium scutatum* (Schlegel)

In the last week in March, I took two of this species by the Fredericksburg Road, about three miles north of Lebanon. They were close together under moss in a swampy situation at the foot of a little wooded hill. Both were inactive, and made no effort to get away. It may be added that at the same spot I took Muhlenberg's turtle, *Clemmys muhlenbergii.*

10. *Bufo fowleri* Hinckley

Great numbers of these toads were heard and observed along Little Swatara Creek, and judging from the quantity of them assembled, they are common in the county. On June 12, on the edge of one cluster of Fowler's toad, a single specimen of *Bufo americanus* was observed trilling.

11. *Bufo americanus americanus* Holbrook

The only specimen I have seen is listed above, but I have heard them singing at Lake Conewago, and have seen the tadpoles at Light's Dam, north of Lebanon; hence it may be inferred that the species is common.

12. *Hyla crucifer* Wied

Myriads of this little frog are to be heard and taken along every stream and body of water in the early spring. After the period of calling, this species is hard to find.

13. *Acris gryllus* (Le Conte)

Four small specimens of this frog were taken in June under leaves in a moist area, about thirty feet from a brook that feeds Lake Conewago. I have heard them in chorus in the middle of July in Bucks County.

14. *Rana sylvatica* Le Conte

One specimen of this frog was taken on the south slope of Blue Mountain in a dry rain-brook bed.

15. *Rana pipiens* Schreber

This frog is not very common in the county. I took two very large, green specimens at Greenville, on the banks of the Little Swatara Creek. Both endeavored to escape in the grass away from the water. Surface reports the species from Lebanon.

16. *Rana palustris* Le Conte

This frog is very abundant in the South Mountains. One stream near Penryn Park had more than I have ever seen at one place elsewhere. It is an upland form, preferring the cool mountain streams.

17. *Rana clamitans* Latreille

A very common frog, seen at its best in the fronds along the little Swatara Creek.

18. *Rana catesbeiana* Shaw

Wide spread, but not numerous. Seen in Lake Conewago and the Pumping Station Dam.

This county list presents nothing, so far, unusual, and agrees with the records for the adjoining counties (see Fowler's records, COPEIA, and Surface's records for Berks County). The animals themselves are numerous but the diversity of species is not great. The populous condition in this area has probably contributed toward the rarity of certain forms, or has driven them away.

HAVERFORD COLLEGE, HAVERFORD, PENNSYLVANIA.

Herpetological Notes

REPRODUCTION IN THE EASTERN BOX-TURTLE *TERRAPENE CAROLINA CAROLINA* (LINNÉ).—The eastern box-turtle, *Terrapene c. carolina*, has been studied by the writer for several years under what may be appropriately termed restricted natural conditions. A small area where turtles of this species were found to occur naturally was enclosed with woven wire and boards, and in this enclosure their life and habits were easily followed. Observations also were made on individuals in their natural haunts.

Mating takes place in this species at any time during the active part of the season, but it is most frequently observed either soon after the individuals come out of hibernation, or late in the season before they go into hibernation, particularly just after a rain. The method of mating is usually as described by Cahn and Conder.[1] However, during the mating process, the body of the male frequently rests upon that of the female, the area of contact being the concave depression on his plastron. One female that was kept away from males from the fall of 1930 until the following summer, laid three eggs on July 14, all fertile. This indicates that the frequent matings observed before hibernation in the fall have a purpose, in fact result in some of the females becoming fertile.

On fourteen different occasions during the summers of 1930 and 1931, females were observed digging nests or laying eggs. The data acquired relative to oviposition, incubation, etc., are presented in the following table.

Oviposition, Incubation, etc., in Terrapene carolina carolina (Linné)

Eggs laid	No. laid	No. fertile	First young emerged	Last young emerged	Incubation period[2]	Remarks
June 23, '30	3	2	Sept. 11	?	Over 80 days	Nest dug into on Sept. 11; 2nd. individual hatched same day
June 24, '30	3	1	Before Sept. 14		Less than 82 days	Two eggs infested with flies of family Phoridae
July 1, '30	5	?				At least 3 eggs not fertile. Two eggs eaten out by ants
July 3, '30	4	4	Sept. 10	?	Over 69 days	Young in 2 eggs were killed by ants
June 22, '31	3	3	?	?	Over 96 days	All eggs dug out of soil Sept. 26, then all hatched
June 23, '31	3	?			Over 103 days	Eggs dug out on Oct. 4; 2 hatched, 1 cleaned out by ants
June 25, '31	3	3	Sept. 20	?	Over 87 days	Nest dug out Sept. 20; 2 eggs hatched, 1 with dead embryo
June 28, '31	3	?	Oct. 6	?		Nest dug out Oct. 6; 2 eggs hatched, 1 cleaned out by ants
July 2, '31	2	2	Oct. 5	Oct. 5	95 days	Embryo died in 1 egg
July 2, '31	3	?	Oct. 12			Turtle in 1 egg died without emerging
July 13, '31	3	3	Between Nov. 15 and 21	?		Last egg hatched on Nov. 21
July 14, '31	3	3	?			One egg had not hatched by Oct. 27
July 14, '31	1	0				Female had been kept away from male since fall of 1930
Before July 14, '31	3	1				Embryo in fertile egg died before time of hatching

From this table we learn the following: The earliest date of egg laying was June 22; the latest date was July 14. The average date for egg laying was July 1. The average date for the emergence of the first young individual of a nest was September 26. The average number of eggs laid at any one time by a female was 3. The percentage of eggs found to be fertile was 78.6. The percentage of eggs cleaned out by ants was 14.3. The percentage of fertile eggs hatching, i. e., embryos not killed, was 72.7.

[1] COPEIA, 1932 (2): 86-88.

[2] By incubation period the writer means the period elapsing between the date of oviposition and the average date of emergence. The period thus reckoned is longer than the true incubation period since the newly hatched young require considerable time to reach the surface of the ground.

In view of the fact that some young turtles were found to emerge in November and that one egg did not hatch until November 21, it might be assumed that a small percentage of the young do not emerge before spring at the latitude of Washington, D.C. Most of those not emerging in the fall might freeze to death during the winter.

Each turtle had a different number painted conspicuously on its carapace, hence could be followed from season to season as well as during the season. One female, number 38, in digging the hole in which to place her eggs encountered a cinder, and could not excavate to the desired depth. This was on June 28. She did not oviposit; but later, on July 3, she dug a normal hole and laid 4 eggs. The first young individual to emerge from this nest came out September 10, earlier than the average date for first emergence.

The method of hatching from the egg was observed in a few instances. In none of these was the egg tooth used for breaking the shell. The young usually emerged from the shell through a longitudinal rip, or suture, which was made by the claws of one of the legs, or in some instances by the claws of both legs on one side working together.

The method by which the female digs the hole for depositing her eggs and covers them has been well described by others, and need not be mentioned here. It should be noted, however, that in every instance observed in 1930 and 1931 the digging process was started in the afternoon or early evening. On one occasion the first egg was deposited as early as 3:40 P.M., on another the digging of the hole was not started until after 6:45 P.M.—H. E. EWING, *U. S. National Museum, Washington, D. C.*

THAMNOPHIS SAURITUS PROXIMUS (SAY) IN CENTRAL AMERICA.—Herpetologists who have been interested in the garter snakes have been somewhat surprised that the ranges of several of the species occurring in Central America have not been extended as a result of the field work that has been done in that region in recent years. Of the most southern forms, *T. sauritus proximus* has not been recorded south of British Honduras, and *T. eques* and *T. scalaris* south of Guatemala. A specimen of *T. sauritus proximus* in a collection made by Mr. Austin Smith, and acquired by the Museum of Zoology, University of Michigan, very materially extends the range of the genus. It was taken at Cartago, Costa Rica. It is interesting to note that the specimen has the reduced number of sub-caudals and ventrals characteristic of the Central American material that has been examined. The scutellation is as follows: upper labials, 8; lower labials, 9-10; ventrals, 154+1; sub-caudals, 91; dorsals, 19-17.—A. G. RUTHVEN, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

HEMIDACTYLUS TURCICUS IN CUBA.—It was my good fortune to collect a specimen of *Hemidactylus turcicus* (M.C.Z. No. 34257) at Central Soledad, Cienfuegos, Cuba, during the latter part of August, 1932. It has not, in so far as I have been able to find out, been reported from Cuba before. There is a possibility that it has been recently introduced there by way of Key West, Florida, as there is a specimen (M.C.Z. No. 29129) from that locality and Mr. C. F. Kauffeld has also reported finding it at Key West (COPEIA, 4, 1931: 164). The bulk of Key West traffic, however, is with Habana and *Hemidactylus turcicus* is not known from there.

Species of the family Gekkonidae seem to be particularly susceptible to getting themselves introduced. For instance *Hemidactylus mabouia* has been so successfully introduced into either South America and the West Indies from Africa or in the reverse direction that there is considerable question as to where it is indigenous. It has been collected from many parts of Brazil, Porto Rico, Petite Martinique, Trinidad, Haiti, St. Kitts, and other localities. Its known distribution in the Western Hemisphere is therefore much more extensive than that of its near relative *H. turcicus*.—BENJAMIN B. LEAVITT, *Museum of Comparative Zoology, Cambridge, Massachusetts.*

A CASE REPORT ON THE POTENCY OF THE BITE OF A YOUNG COPPERHEAD.—On October 1, 1932, I had the occasion to record the effect of the bite of a 15-day old copperhead, *Agkistrodon mokasen* Beauvois, on myself.

The specimen involved in the present report was one of ten healthy young snakes, which were retained alive as the best of a group of 23, and the offending individual was believed to possess its full quota of venom. The bite was inflicted at the tip of the right thumb at 10:30 A.M., and one of the interesting events concerning it was that the young snake held on tenaciously after the fashion of a bulldog until it was lifted free of its cage for a distance of perhaps two feet and flung involuntarily for a distance of about nine feet from the cage. The length of time the reptile held on was judged by a competent bystander and myself to be about eight seconds. Due to the fact that the reptile was immediately caged with the other nine specimens after the accident its identity was lost, and a later attempt to ascertain whether or not it had expended its full supply of venom was impossible.

No symptoms were noted until about 30 seconds after the bite was inflicted, and then an acute stinging sensation was felt in the vicinity of the wound and within three minutes this had spread to the fore part of the wrist, painfully including the first two fingers. Sharp, shooting pains were noted in the entire right arm at the end of five minutes; these pains began to dull by 10:45 A.M., and were replaced by a tight, choking sensation in the right lung. At all times the right arm felt more or less useless, with the sensation of having gone to sleep. At 10:50 A.M., pains were centering rather closely about the elbow, and the thumb and adjacent parts were so numb that little feeling was left.

By 11 A.M., the pains had centered in the right lung where the feeling of suffocation was still evident and there was a sensation very much like that of a heavy weight being pressed upon this organ.

At 11.15 A.M., the numbness was leaving, although the whole right side above the waist felt very tired and dull pains were present in the joints. At the end of five minutes no more pain was experienced, but the knuckle of the thumb ached when bent and a dull but severe ache was noted in the pectoral muscle. The right lung still seemed choked and still ached. No record was made from this time until 12:45 P.M., when the only symptom was a dull ache in the pectoral muscle, which completely vanished by 1:20 P.M.

At no time was there a feeling of nausea nor was there any swelling in the hand or arm, and from the time of the accident until 11 A.M., rather strenuous duties were performed, then a drive of about three miles was taken and I rested at no time while symptoms were noted.—DOROTHY A. BOYER, *Mount Olympus, Kimmswick, Missouri.*

NOTES ON TYPE SPECIMENS OF REPTILES AND AMPHIBIANS IN THE "ALFREDO DUGÈS" MUSEUM, GUANAJUATO, MEXICO.—Of the collections of reptiles and amphibians made by Alfred Dugès in Mexico from about 1863 to 1894, many specimens were scattered in museums both in the United States and Europe. Most of the new species discovered were described by other herpetologists; however, several species and subspecies were described by Dugès himself, and the whereabouts of these types have been lost sight of, although it has been presumed that they were in the Museo Nacional de Mexico.

While in Mexico in the summer of 1932, I examined the collections in the Museo Nacional, but none of Dugès types were found. Later I learned of a museum in the city of Guanajuato, in the state of the same name, and on visiting this city, I found the "Alfredo Dugès" Museo housed in a room in the Colegio del Estado de Guanajuato.

Privilege of entering was granted with the greatest reluctance despite the fact that the museum is used as a classroom for classes in biology. A search among the numerous jars of specimens in such cabinets as were opened for me, revealed a number of specimens designated as types. The following were observed: *Eumeces altamirani, Eumeces rovirosae, Hemichirotes tridactylus, Hemidactylus navarri, Scolecophis michoacanensis, Rhinocheilus antonii, Hemigenius variabilis, Geatractus*

tecpanicus (genotype), *Storeria dekayi anomala, Elaps diastema michoacanensis, Adelophis copei, Erythrolamprus grammophrys* and *Ambystoma altamirani.* It is probable that others are present.

Permission to examine the specimens save through their glass containers, was refused. As a consequence of this superficial examination in a poorly lighted room, I was unable to form definite opinions of their validity in all instances, and further study is necessary before the status of many of these forms can be accurately determined.—EDWARD H. TAYLOR, *Department of Zoology, Kansas University, Lawrence, Kansas.*

AN UNUSUAL FEEDING RECORD FOR THE PRAIRIE RATTLESNAKE.—The food of the prairie rattlesnake, *Crotalus confluentus confluentus* (Say), is known only in a general way. The experiences of most observers indicate that it, like other rattlesnakes, seems to have a preference for warm-blooded prey. In a few instances it has been known to eat lizards and frogs but I have seen no records of its having fed upon snakes. It seems worth while, therefore, to report an instance in which a prairie rattlesnake appears to have fed upon a relatively large individual of the same species which may have been dead for some time.

A box containing four large prairie rattlesnakes sent by Mr. R. M. Cole, Sunburst, Montana, reached the Zoological Laboratory on September 27, 1932. Besides the four live snakes there was most of the body of a fifth, almost as long as the others but without a head. It was badly decomposed and very soft but the cuticle of the skin was largely intact and the pattern still distinct. The rattle was present. Its appearance of having been partially digested and the odor characteristic of regurgitated food masses observed on previous occasions suggested that it might have been swallowed by one of the others and regurgitated in transit.

In reply to my inquiry, a letter from Mr. Edward A. Wood, who assisted in collecting the specimens, gives a possible explanation of this most peculiar occurrence. I quote, in part, from his letter: "When we discovered one of the snakes on a steep, rocky slope, we observed that it was unusually plump looking and that it made no effort to escape. It put up very little fight and made only a slight effort to dodge the snare. The other three all tried to get away and fought and struck viciously when we got them cornered or pinned.

"We carried them down to the car in the bags you supplied and not over twenty minutes later placed them in the box, examining the contents of each bag carefully with a view of culling out any specimen that showed any sign of injury or bad condition. All four looked fine and except for some shavings the box was empty when we introduced the four snakes. In the drive of some twelve miles to the express station, in a closed car, we noted the offensive odor but thought it not unusual for a box of live rattlesnakes,—all in a bad humor. There was a lapse of some two hours between leaving the field and seeing the box put into a baggage car. At the time the box was loaded into the car, I noticed that the odor had become very much more eloquent.

"About three days before we went after your specimens we had visited the same spot and killed I should say twenty or thirty adult snakes and as many small ones. A few days before that, another party had made a big killing within 50 yards of the same place. These carcasses were strewn all about and were in various stages of decomposition. Some were in good condition yet. Nearly all had their heads shot off. I am wondering if this is not a case in which a rattlesnake fed upon another one freshly shot?"

An alternative that might be suggested is that the two snakes attempted to swallow a single article of food, such as a small rodent, and that the larger, after engulfing the rodent, continued swallowing while the smaller snake, unable to extricate itself, also became a victim. Almost everyone who has kept snakes in captivity has observed tragedies, or near-tragedies, of this sort. Mr. Wood's explanation, however, seems especially plausible since it accounts for the missing head of the regurgitated carcass.—H. K. GLOYD, *Department of Zoology, University of Michigan, Ann Arbor, Michigan.*

NOTES ON COLORADO REPTILES.—A combined mammal and reptile collecting trip to Montezuma County, in the southwestern corner of Colorado, was made, early this spring (1932), by Robert Landberg, of the Mammal Department of the Colorado Museum of Natural History, and the writer. A number of interesting facts were brought to light concerning the abundance of the reptiles of Colorado and one new lizard was added to the state's list.

1. *Crotaphytus wislizenii* Baird and Girard

A beautiful specimen of this lizard was taken about one-half mile east and one-fourth mile north of the point common to Colorado, New Mexico, Arizona and Utah, which is known as Four Corners. *Cnemidophorus t. tessellatus* is very common in this particular region and a few were being taken from the dry sandy bottom of a ravine near our camp, when a large *C. wislizenii* ran out into the open from beneath a Russian thistle. While not unexpected in Colorado, as it is to be found in adjoining states, this specimen is a welcome addition to the collection as it necessitates an extension of the range of *C. wislizenii* to include Colorado.

2. *Holbrookia maculata approximans* (Baird)

The first record of this species from the state was published in COPEIA in 1932 (No. 2: 103). Four additional specimens were seen on our trip this spring, two of which were collected. Both of these were taken in Montezuma County; one at the point where the Mancos River crosses the State Highway No. 666 and the other two miles north of the Colorado-New Mexico line on the same highway. The two specimens which we failed to collect were observed at the latter locality.

Mr. Donald Watson of the National Park Service, who is stationed at Mesa Verde National Park, donated a specimen of this lizard which he collected on top of the Mesa. Mr. Watson reports having seen another near the Park Headquarters.

H. m. approximans may now be considered as locally common in Colorado.

3. *Hypsiglena ochrorhyncus* Cope

The first record for Colorado was published with the record of *H. m. approximans* as mentioned in the preceding note. This record has been further substantiated by an additional specimen in our collection. Ranger Donald Watson, who has been given credit for finding the first *H. ochrorhyncus* in Colorado, donated another specimen taken near Sun Temple, Mesa Verde National Park, on July 25, 1932. The record for this snake in Colorado is now based on two specimens, both of which are in the collection of the Colorado Museum of Natural History.

4. *Liopeltis vernalis* (Harlan)

The records for this species in this state are based upon three specimens. The first was taken by W. C. Ferril, who was then Curator of the State Historical and Natural History Society of Colorado, at Palmer Lake, El Paso County, in 1900. This specimen is now in our collection. In the collection of the National Museum there is a *L. vernalis*, taken by Merritt Cary, at Vallecito, La Plata County. The third specimen was collected by G. A. Smith at Boulder, Boulder County, in 1911.

For the past 21 years no reports have been made concerning the finding of *L. vernalis* in this state and this fact led the writer to believe that perhaps this species could not be included in a present day list of Colorado reptiles. While on our trip to Mesa Verde in 1932, the identification of a snake was checked for Mr. Paul R. Franke, Ranger-Naturalist at Mesa Verde National Park, and his identification of the specimen as *L. vernalis* was confirmed. This snake had been collected near Far View House, Mesa Verde, in 1930. Mr. Franke reports having seen an additional specimen of the smooth green snake at the same locality this year.

5. *Masticophis taeniatus taeniatus* (Hallowell)

The same condition has existed with regard to records of *M. taeniatus taeniatus* in Colorado as those of *Liopeltis vernalis*. There are, in the United States National Museum, four specimens of this species taken in this state. The localities were—Plateau Creek, Garfield County, 1906; Rifle, Garfield County, 1907; two from Canyon Creek, Garfield County, 1882 and 1898. There have been no records of

this species for the past 25 years. This is due, without doubt, more to the fact that very little work has been done on Colorado reptiles than to its scarcity.

Three specimens were collected during the trip through the southwestern part of Colorado; one from Mc Elmo Canyon, Montezuma County, and two from Paradox Valley, Montrose County. Ranger-Naturalist Paul Franke reports having seen a "long, tan snake with stripes running lengthwise" on top of the Mesa, Mesa Verde National Park. This description could not be applied to any other snake in this region as the genus *Thamnophis* is not represented on the Mesa top.

During the past year three lizards and two snakes have been added to Colorado's list; *Sceloporus magister, Holbrookia maculata approximans, Crotaphytus wislizenii, Thamnophis sauritus proximus* and *Hypsiglena ochrorhyncus*.—LEWIS T. BARRY, *Colorado Museum of Natural History, Denver, Colorado.*

FURTHER NOTES ON SPADEFOOTS (*SCAPHIOPUS HAMMONDII*).—The notes of Witmer Stone, Remington Kellogg and Morrow Allen on spadefoot toads in recent numbers of COPEIA were very interesting, for they show that little by little we are learning the habits of these mysterious animals. I have had rather similar experiences which I believe should be recorded. In Arizona, near Peña Blanca Springs, Santa Cruz Co., I was hunting owls with the aid of a flashlight when I ran across a spadefoot hopping around in a small clearing in a scrub-oak forest. That was August 31, 1931, at 9:00 P.M. The ground there-abouts was fairly sandy, and, as the rainy season was well along, not very dry. No burrows could be found in the immediate vicinity. September 4, at night, I collected another of the same species in a sandy wash-bottom a half-mile or so from the place where the first was taken. Both were adults. Half-grown larvae were found in a pool nearby. The plant association in this vicinity was oak, walnut, and grass; the terrain hilly.

On September 6, we left the Peña Blanca area and went down to Continental, a small town in the broad Santa Cruz Valley. That evening, at sundown, there was a light thundershower, and when it became dark and the rain was over, I went out in search of spadefoots. I left town towards the north and east, and when away from the noise of radios and dogs, I heard a chorus to the southwest. It seemed to come from a pool in some back-yard perhaps 100 yards away. I followed the noise for a mile or so to a large open prairie on the other side of the village in which temporary pools had formed in a few depressions. The noise of the spadefoots, which I had first heard, was nearly drowned out by the calling of the other toads, *Bufo cognatus* and *B. woodhousii*, near the pools. Here was an interesting situation: all of the toads in the pools were males, calling their loudest, while out in the grass were females of each species represented in the chorus. No males were found out of the water. The females were evidently feeding, for they were widely separated and headed in all directions. Numerous sub-adults were with them. Very likely the breeding season was over and the ovaries of the females were spent, thus relieving them of the breeding instinct. The males seemed to exhibit no such diminution of ardor. Of all this, however, the point is that spadefoot females were out feeding in the grassy meadows in company with the other common toads of the region.

A few days later, at Rillito, near Tucson, Arizona, a spadefoot was encountered in the mesquite wash association. It was after dark and I was hunting with the aid of a flashlight when I heard a rustling in the sand. It was a *Scaphiopus* and I captured it, but unfortunately lost it later.—BERRY CAMPBELL, *Johns Hopkins Medical School, Baltimore, Maryland.*

RANA SYLVATICA IN ARKANSAS.—While I was doing general zoological collecting in the Ozarks this past summer my friend, Richard Page, Jr., brought me, on August 12, 1932, a large adult female specimen of *Rana sylvatica* Le Conte. He had captured the frog in a woodlot, at an elevation of about 2200 feet, 2 miles south of Winslow, Washington County, Arkansas. The specimen, now No. 16526 in the University of Kansas collection, is a large pale-colored one, quite similar to the first figure of the species given in Dickerson's "The Frog Book" (Plate XIV, Fig. 1).

This record of the species appears to be the first for the state of Arkansas. It has long been known from Missouri. Hurter (Trans. Acad. Sci. St. Louis, 20, 1911:

124) reports specimens from St. Louis in the Smithsonian collection, and states that he has collected the frog near Marble Cave, Stone County, Missouri.

Cope (Bull. 34, U. S. Nat. Mus., 1889: 437) reports *R. cantabrigensis* from western Missouri (Cooper County).

While I have not seen this latter group of specimens it is probable that they will prove to be of the same species as those reported by Hurter.

The rarity of the frog in Missouri indicates that its distribution is discontinuous. The possibility suggests itself that such a condition of distribution might have been brought about by the last glacial age, with these apparently limited areas of present distribution being the vestiges of a once wide range through Missouri and northern Arkansas, at a time when the ice sheet extended much farther south than at present.—J. D. BLACK, *Museum of Mammals, University of Kansas, Lawrence, Kansas.*

THE EASTERN LIMIT OF RANGE FOR *CHRYSEMYS PICTA MARGINATA*.—Storer's paper on "The Western Limit of Range for *Chrysemys picta bellii*," in a recent number of COPEIA, has suggested a comment on the eastern limit for *Chrysemys picta marginata*. Bishop and Schmidt, in their recent review of the genus, state: "Basing our judgment on the material examined, we may limit roughly the area in which intergradation occurs in New York state to the valley of the Hudson as far north as Saratoga and south at least to the Palisades Interstate Park. How far the area may extend beyond these limits we have not been able to determine." In the collections of the Museum of Comparative Zoology and the Boston Society of Natural History, I find specimens showing intergradations with *C. picta picta* from Nantucket, Pasque Isle, Brookline, Cambridge, and Middleboro, Massachusetts; Lake Dunmore, Vermont; Ossippee, New Hampshire; and Norway, Maine. It thus appears that this intergrading area extends through New England to the Atlantic coast.—HAROLD L. BABCOCK, *Boston Society of Natural History, Boston, Massachusetts.*

COLOR PATTERN AND SEX IN *HYNOBIUS STEJNEGERI* DUNN.—As I have mentioned before,[1] the body coloration of *Hynobius stejnegeri* is of a tortoise-shell pattern which shows much individual variation.

In the district of Mamihara,[2] Aso-gun, Kumatoto-ken, Japan, where I collected specimens in the spring of 1931, the people call the animals rich in yellow markings "gold," and those which have a few small, yellow spots or those individuals that are devoid entirely of any markings "silver." However, there exist individuals having a color pattern somewhere between "gold" and "silver," which I shall call here "intermediate" for the sake of convenience.

Describing his *Hynobis ikishimae*, Dunn mentions[3] that the males of the species are generally darker than the females. According to my observations of many live and preserved specimens, there is no such difference between the two sexes in *H. ikishimae*.[4] This independence of sex in the body coloration has been proved to be true also in *H. tsuensis* Abe.[5] Now, is there any relationship between the body coloration and the sex of *H. stejnegeri*, the Japanese "tortoise-shell" salamander?

In examining 46 adult individuals of *H. stejnegeri* I have, for the third time, come to the same negative conclusion. My specimens have been classified under the above mentioned three categories, "gold," "silver" and "intermediate," and the relationship between the color pattern and sex has been studied.

The relationship is shown in the following table, representing 46 specimens.

	Male	Female
"gold"	13	10
"silver"	9	7
"intermediate"	3	4

Thus, so far as my materials are concerned, it may be concluded that no relationship between the coloration and the sex exists in *H. stejnegeri*, and that the color pattern of this animal is nothing but an expression of individual variation.—JUNJI OYAMA, *Kyûshû Imperial University, Fukuoka, Japan.*

[1] COPEIA, 1931 (3); *Amoeba*, 3, (1-2), 1931.
[2] The citation of the place as "Umamihara" in COPEIA, 1931 (3), was erroneous.
[3] *Proc. Amer. Acad. Nat. Sci.*, 58 (13), 1923: 494.
[4] According to my opinion this is a synonym of *H. nebulosus* (Schlegel): *Annot. Zool. Japan.*, 12 (2), 1930; *Dobutsugaku Zasshi*, 42 (496), 1930.
[5] *Bull. Biogeol. Soc. Japan*, 2 (1) 1930.

Ichthyological Notes

NOTES ON THE FISHES OF THE STATE OF WASHINGTON.—The new records and the notes on fishes of rare occurrence in this state that are given below are based on three series of collections made by the authors: The first in the Lower Columbia River Basin during the summer of 1930; the second among the San Juan Islands in the summer of 1932 while we were stationed at the Oceanographic Laboratories of the University of Washington; and the third in the fall of 1932 aboard two trawling vessels of the shrimping fleet stationed at Everett, Washington. All of the fish mentioned are deposited in the Collection of Fishes of the Department of Fisheries, University of Washington, Seattle.

1. *Chaenobryttus gulosus* (Cuvier and Valenciennes).—In a collection of fishes made by the senior author in a slough of the Kalama River, near Kalama, Washington, were found several specimens of the warmouth bass, which is the first record of the species from the state of Washington. This species was probably introduced from the Mid-West.

2. *Helioperca incisor* (Cuvier and Valenciennes).—In the same collection with *Chaenobryttus gulosus* were found two specimens of *Helioperca incisor*. This species has not been recorded previously from Washington or Oregon and was also probably introduced from the Mid-West.

3. *Prionistius macellus* Bean.—One specimen was taken at a depth of 15 fathoms off Lopez Island and two others were collected in Saratoga Passage at a depth of 30 fathoms. Starks (Ann. Carn. Mus., 7, 1911: 187) gives the only previous record of this species from Puget Sound.

4. *Synchirus gilli* Bean.—Two entirely green specimens of *Synchirus gilli* were taken among the *Ulva* on the logs of the float at the Oceanographic Laboratories. Dr. L. P. Schultz also obtained a specimen from False Bay, San Juan Island, on July 26, 1930. Only one specimen of this species has been recorded from Puget Sound before (Evermann and Goldsborough, Bull. U. S. Bur. Fish., 26, 1906 (1907): 325).

5. *Leptoclinus maculatus* (Fries).—We took 18 specimens of the "langbarn" in an otter trawl off Orcas Island on August 6, 1932, at a depth of 15 fathoms. Jordan, Evermann and Clark, in their checklist of the fish and fishlike vertebrates of North and Middle America (Rept. U. S. Comm. Fish., 1928 (2): 470), record this species as having been taken in Hoods Canal, Puget Sound. However, Dr. L. P. Schultz and the junior author have examined practically all of the literature dealing with the records and distribution of fishes of Washington and Oregon and have found no reference of this fish ever having been taken in these states, so we do not believe that the above citation can be given full credence. Hitherto this species has been recorded in the Pacific only as far south as Unimak Pass and Kodiak Island, Alaska (Evermann and Goldsborough, *ibidem*: 339), although it is of wide-spread occurrence in the North Atlantic. Therefore our specimens give the species a southern extension of range of about 500 miles.

A study of these fish shows that they agree closely with the description of this species as given by Jordan and Evermann (Bull. U. S. Nat. Mus., 47 (3): 2433). Following are measurements in hundredths of standard length and fin ray counts (minimum, maximum, and average) for these 18 specimens of *Leptoclinus maculatus*, which vary in length from 86 to 118 mm. (the average values are given in parentheses): Length of eye 18.6 to 23.2 (20.8); length of snout 20.4 to 26.5 (21.8); length of maxillary 12.1 to 16.3 (13.9); depth of body 8.1 to 10.9 (9.0); depth of caudal peduncle 23.2 to 34.0 (27.6); snout to dorsal 4.7 to 6.3 (5.5); length of pectoral 4.2 to 5.9 (5.4); length of ventral 8.6 to 11.8 (10.7). Dorsal rays 57 to 60 (58.2); anal rays 34 to 36 (34.8).

6. *Ptilichthys goodei* Bean.—Nearly every night during the summer of 1932 we suspended an electric light about a foot above the surface of the water off the float at the Oceanographic Laboratories. In July and August 12 specimens of *Ptilichthys*

goodei were attracted to the light and captured. They swam slowly with a snake-like undulation, but darted swiftly when alarmed. Our specimens lacked the dark markings on the sides shown in the figure of the species by Evermann and Goldsborough (*ibidem*: 342). To our knowledge only 7 specimens of this species have been taken previously (see Schultz, COPEIA, No. 171, 1929: 40-41).

7. *Furcimanus diapterus* (Gilbert).—Four specimens were taken at a depth of 30 fathoms by a shrimp trawler working near Gedney Island. We have seen no previous record of this fish from Puget Sound, although it has been reported as taken in depths of 82 to 376 fathoms off the coasts of Oregon and California (Gilbert, Proc. U. S. Nat. Mus., 14: 564) and from north of Unalaska (Evermann and Goldsborough, *ibidem*: 344). Since our specimens differ slightly from Gilbert's description, we include our measurements and counts (minimum, maximum, and average) of these four specimens ranging in standard length from 164 to 209 mm. Measurements in standard length: length of head 5.0 to 5.3 (5.2); length of pectoral 7.6 to 9.0 (8.2); snout to dorsal 4.0 to 4.9 (4.2); snout to anal 2.4 to 2.7 (2.6); snout to base of pectoral 4.8 to 5.0 (4.9); snout to end of pectoral 3.0 to 3.1 (3.1); snout to ventral 6.1 to 6.9 (6.6); depth 9.1 to 10.9 (10.1). Measurements in head: length of pectoral 1.4 to 1.7 (1.6); length of ventrals 7.0 to 7.8 (7.5); length of maxillary 2.6 to 3.0 (2.8); length of mandible 2.8 to 3.7 (3.3); longest diameter of eye 3.3 to 3.9 (3.7); length of snout 2.7 to 3.3 (3.1); width of interorbital bone 15.6 to 19.5 (17.5). Measurements in eye: width of interorbital bone 4.4 to 5.0 (4.7); length of ventrals 1.7 to 2.2 (1.9). Dorsal rays 109 to 117 (114.3); anal rays 101 to 107 (104.5).—WILBERT M. CHAPMAN and ALLAN C. DELACY, *Department of Fisheries, University of Washington, Seattle, Washington.*

VENTRAL AXILLARY SCALES IN *AMBASSIS*.—In using the excellent key to the Indo-Australian species of *Ambassis* given by Weber and de Beaufort (The Fishes of the Indo-Australian Archipelago, 5, 1929: 398-401), for the identification of Siamese fishes of this genus, I was confronted with the statement that a ventral axillary scale is absent in *Ambassis* (in contradistinction to *Psammoperca*), whereas all specimens in hand, representing half a dozen species, showed this appendage. Turn-to Bleeker's *Atlas Ichthyologique* (8), I found that in all of the ten species figured by him no ventral axillary scale is represented. I thereupon wrote to Dr. L. F. de Beaufort, who replied in his usual courteous manner, writing from the Zoological Museum in Amsterdam, under date of December 12, 1932, and January 12, 1933, as follows:

(1) I have had a look at our *Ambassis* collection and found an axillary scale at base of ventrals in all well-preserved specimens I examined. It is true that the axillary process in *Psammoperca* is longer, but the difference is not sufficient to use it in our key to the genera of Centropomidae as we did. Tomorrow I see Max Weber (who, by the way, is now 80 years old but still going strong) and will talk with him about this mistake.

(2) Our mistake about the absence of an axillary process in the ventrals of *Ambassis* was caused, as we found out, by an erroneous statement of Bleeker in the Atlas, but Klunzinger (Die Fische des Rothen Meeres, 1884) had already pointed out Bleeker's mistake.

HUGH M. SMITH, *Bureau of Fisheries, Bangkok, Siam.*

A CORRECTION CONCERNING *STEREOLEPIS INOKO* SCHMIDT.—In my paper, "Fishes of Japan, collected in 1901" (Trans. Pacific Comm. Acad. Sci. U.S.S.R., 2, 1931: 52) I described as a new species *Stereolepis inoko*, a fish obtained in Kagoshima, southern Japan. Now comparing the single type specimen with *Therapon jarbua* (Forskål) (=*T. servus* Bl.), I find that it is identical with this tropical species, which is very rare in Japan. The species *Stereolepis inoko* must therefore be abolished. I am very much indebted to Dr. A. Fraser-Brunner (London) for the suggestion that this comparison be made.—PETER J. SCHMIDT, *Academy of Sciences, Leningrad, U.S.S.R.*

COLOLABIS SAIRA FROM QUEEN CHARLOTTE ISLANDS, BRITISH COLUMBIA.—A northward extension of the known range of the saury, *Cololabis saira*, is afforded by a specimen taken October 18, 1931, in brackish water in the Ain river, about two hundred yards upstream from its outlet into Massett inlet, Queen Charlotte islands. Massett is a long inlet opening on the north coast of Graham island, the northern-most island of the Queen Charlotte group. This specimen is

No. 7847 in the collection of the Royal Ontario Museum of Zoology, Toronto. This extension of range tends to confirm the identification of the California form (*"brevirostris"*) with the Japanese *saira*.—A. L. PRITCHARD, *Pacific Biological Station, Nanaimo, British Columbia.*

NOTES ON THE HABITS AND COLOR OF A GOBY FROM BRITISH COLUMBIA.—On April 3, 1933, while digging for sand shrimps at a 3.4-foot tide on the border zone of mud and sand at the head of Departure Bay, British Columbia, Miss J. Hart observed several small fish of rather unusual appearance which moved with astonishing agility and, under cover of a protective screen which they set up in the turbid water, buried themselves so completely that they became quite invisible.

These specimens were identified as *Clevelandia ios* (Jordan and Gilbert), and the determination has been checked by Dr. Carl L. Hubbs.

At this time three specimens were obtained, 31 + 8 mm., 24 + 6 mm. and 23 + 6 mm. long respectively (standard + caudal fin lengths). On April 11 four more of these gobies were obtained, all about the same size as the first specimens. These were taken to the laboratory of the Pacific Biological station where the following observations were made.

The ground color in life is a pale olivaceous to tawny, spotted with black. Upon close examination the body is seen to be covered throughout with minute punctulations of light orange, arranged without apparent pattern except around the black chromatophores where they are almost evenly spaced in small circles enclosing each individual melanophore. In addition to these colors there are several quite large spots of opaque iridescent white placed under the eye, on the posterior of the opercle and in front of the pectoral; 13 or 14 similar patches evenly spaced are seen upon the midlateral region between the pectoral and caudal base. These opaque patches and the orange pigment spots fade rapidly at death.

In an aquarium, the floor of which was well covered with sand, these gobies if startled would quickly bury themselves by rapid vibrations of their bodies, the wriggling action being greatly assisted by movements of the pectorals acting alternately. When completely hidden a small ebullution of sand caused by the rapid contraction of the opercles would indicate where the mouth of one of these fish was to be found. If left undisturbed a few more slow expansions of the under side of the head followed by rapid contractions would cause a small pit to form in front of the mouth and a shallow excavation on each side of the body immediately behind the head.

During the expansions the head from a top view appears to swell to almost three times its normal size, the swelling extending from the region immediately beneath the eyes to the posterior of the operculum. Posteriorly the soft edge of the operculum always remains closely applied to the body beneath to prevent the entrance of sand, etc.

The rate of breathing varies considerably. After burial the first regular pulsations were about 40 per minute. As soon as a water passage had been made the rate increased to about 50 or 60, varying with the different individuals. At a temperature of 25° C. the fish were still alive but apparently in distress and the breathing rate increased to about 80 per minute.

These fish seem to be able to resist considerable rough handling and can withstand quite a considerable range of temperatures.—G. V. WILBY, *Pacific Biological Station, Nanaimo, British Columbia.*

Reviews and Comments

A CHECK LIST OF NORTH AMERICAN AMPHIBIANS AND REPTILES. By Leonhard Stejneger and Thomas Barbour. Harvard University Press, 1933, xiv + 185 pp. $4.00.—The appearance of the third editoin of this check list will be hailed as an important event by students of herpetology. The other editions have demonstrated that the work is an important one both to the isolated student and to the expert surrounded by an abundance of library and museum facilities. Meticulously prepared by two scholars noted for their experience and good judgment, the list summarizes our knowledge of the subject, and stabilizes nomenclature to a highly satisfactory degree.

Ae the reviewer has remarked in his comments on the second edition, the book is a good register of progress in the field which it covers. It is interesting to note that the work recognizes as additions to the fauna listed in the 1923 edition three genera, two of them Mexican invasions (*Leptodactylus, Oxybelis*), and one new (*Micruroides*), and fifty species and subspecies of which seven are invasions, one is a Cuban introduction (*Hyla septentrionalis*), fourteen are re-established, and twenty-eight have been described since the appearance of the second edition. Three genera (*Verticaria, Siagonodon, Amphiardis*) and twenty-four species and subspecies have been synonymized, and four forms (*Hyla phaeocrypta, Holbrookia maculata campi, H. m. flavilenta, Verticaria franciscensis*) are dropped without comment. The fact that fifty-seven names have been changed is also an indication of the intensive study which is being given to the nomenclature and systematic relationships of this group. Most of the changes are concerned with the recognition of subspecific status and with the insistence of the authors that names of type species shall appear as trinominals. While this practice smacks of pedantry and is wasteful of good ink, the rule should perhaps be adhered to while it exists.

The steady improvement in the description of geographic ranges noticeable in the three editions is praiseworthy. Evidently the descriptions now include not only the published records, but also unpublished ones represented by museum specimens. This feature of the third edition will particularly expedite the work of the student who does not have immediate access to the large collections.

It is no pleasant task to criticize such a meritorious and painstaking attempt to serve a growing group of students, and indeed there is little room for criticism. Two omissions have been corrected by the authors in the introduction. The reviewer notes that the authority for the name *Gyrinophilus porphyriticus duryi* is incorrectly given as Waller instead of Weller, and that the names *Leurognathus marmorata* and *Kinosternon bauri* should be in the trinomial form. From even such minor errors, however, the book is singularly free and exhibits careful proof-reading.

A more important criticism is an almost amusing inconsistency in adopting the conclusions of monographers. The authors state (p.vi) "Considering as we do, that genera are groups for convenience, that no two people are ever likely to agree for very long on generic limitations, we feel that any means of breaking up large genera by setting off particularly well differentiated species or groups of species is justifiable and praiseworthy." This attitude is understandable, but it is not consistent with the decision to continue to include all of the so-called racers under the old name *Coluber* in the face of anatomical evidence that the group is a composite one. On the other hand the failure of the authors to follow in detail the opinion of monographers can scarcely be objected to if, as it should, the Check List represents the opinions of Stejneger and Barbour. The work is a compilation, but also a critical compilation, and while it is not to be expected that the authors can know as much about each group as the students who have studied them intensely, after all something must be granted to the judgment and experience of these eminent herpetologists. Unquestionably the volume represents the honest opinion of the authors, although probably

not in every case the opinion of both of them. Where either or both have erred, time and the activities of students will correct the mistakes.

The authors are, in the opionion of the reviewer, to be congratulated on having resisted all efforts to expand the work by the addition of keys and descriptions. The book is very useful as a check list, and in size and typography might well serve as a model for similar works on other groups. Above all, the fact that every effort is apparently made to make each edition superior to the last must give to every herpetologist that feeling of pride and satisfaction with which the sincere student observes progress in his field.—ALEXANDER G. RUTHVEN, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

RECENT STATE FISH BOOKS.—During the past few years, a considerable number of state fish books or bulletins have appeared, all issued by the state department of conservation (or corresponding administrative unit) concerned. Each of the authors has made the effort, with varying degrees of success, to present his material in such a manner as to interest and instruct the general reader. None of the booklets may be claimed as important scientific contributions, though all will prove useful to ichthyologists studying the immense North American fish fauna.

THE FISHES OF MARYLAND. By Reginald V. Truitt and Barton A. Bean and Henry W. Fowler. State of Maryland Conservation Department, Conservation Bulletin No. 3, May 1929, pp. 1-120, frontispiece + figs. 1-62.—This booklet, which has apparently not come to the general notice of ichthyologists, gives the results of ichthyological work in Maryland by the three authors, over a period of years. The introductory chapter on *The Biology of the Fish*, condenses within 21 pages a fairly readable account of general ichthyology, the distribution, anatomy, habits and economic importance of fishes. The systematic section is without keys, but each of the 228 species recognized is given a diagnosis, with a statement of general range and a list of Maryland localities by counties. Several freshwater species which have been reported for the state or which I have taken there commonly, such as *Entosphenus appendix, Notropis whipplii spilopterus, Notropis rubellus* and *Hololepis fusiformis* are omitted. The inclusion of the James River montane species *"Boleosoma longimanus"* was an unnecessary error, since it was pointed out to one of the authors that the specimens from Maryland so identified are really *Ioa vitrea.* The nomenclatorial treatment is fairly well though not uniformly modernized. The confusion of the species of *Nocomis* under the old name *Hybopsis kentuckiensis* is retained. The illustrations consist of an original colored frontispiece of the striped bass, two colored plates borrowed from the New York reports (one representing a species unknown in Maryland), and 59 of the government zinc cuts, which though old are a welcome relief from the outline sketches which so imperfectly illustrate some of the modern fish books. One may wonder when the many-times repeated figure of the Mexican *Leptorhaphis infans* will cease to be used to illustrate the male of *Gambusia affinis* (properly *Gambusia affinis holbrookii* in Maryland). This is a valuable little volume, which will serve as a foundation for further exploration in Maryland, particularly in the streams.

HANDBOOK OF COMMON COMMERCIAL AND GAME FISHES OF CALIFORNIA. By Lionel A. Walford. Division of Fish and Game of California, Fish Bull. 28, 1931, pp. 1-183, frontispiece + figs. 1-137.—This is a handbook which is really adequate for the identification by the general public of all the important fish species of the state for which it is written. No time or effort was spared to write the text so as to be understandable, and to obtain excellent original photographs of specimens specifically prepared for the purpose. The simplified, "self-directing key," well supplemented by topographic illustrations and a glossary, is an original feature of this book. Item 23 of the key, to take an example, reads:

> 23. IF: There are no teeth in the mouth, the fish is a Grunion (*Leuresthes tenuis*). (See page 67).
>
> BUT IF: There are teeth in the mouth, *see* section 24.

Each species is assigned one page headed by a fine photograph, under which is a scale in inches and the official common name and scientific name. The text is then divided into seven headings: Relationship, Distinguishing Characters, Distribution, Fishing Season, Importance, Fishing Gear, and Unauthorized Names. A few com-

mercially important invertebrates are treated likewise. Though the stated purpose of the handbook was to standardize the vernacular fish names, especially for further improving the model fishery statistics gathered and analyzed by California, its value, however, must be much wider, both within and without the state. The author and the California State Fisheries Laboratory are to be congratulated on the useability, accuracy and fine appearance of this exemplary handbook.

Some Food and Game Fishes of Ohio. By E. L. Wickliff and M. B. Trautman. Bull. Ohio Dep. Agri., 7, May 1931, pp. 1-40, 28 figs.—This attractive and authoritative little bulletin makes preliminary use of the extensive material being gathered for what promises to be the finest of all the state fish books. It is confined to the more important species, each illustrated by a half-tone taken from the excellent colored plate prepared for the larger treatise, and by a state map showing the distribution records which the authors have gathered in the most thorough ichthyological exploration ever made in one state. The text for each species carries common name, scientific name, other names, distribution, habitat (brief though excellent, as this is the field in which the authors are particularly interested and competent); food; stocking; spawning and propagation; open season, legal length and bag limit.

Fishes of Texas, Handbook of the More Important Game and Commercial Types. Compiled by J. G. Burr. Game, Fish and Oyster Commission, Austin, Texas, Bull. 5, August 1932, pp. 1-41, 35 figs.—This brief but attractively written pamphlet treats about 42 of the more important species of the state. There are no keys and the descriptions are very short, but the species are mostly well illustrated by figures borrowed from the government and state publications. Under each species the range is given, with occasional Texas records, as well as brief natural history notes of general interest, largely based on observations in Texas.

Fishes and Fishing in Louisiana, Including Recipes for the Preparation of Seafoods. By James Nelson Gowanloch. Bull. 23, State of Louisiana Department of Conservation, New Orleans, 1933, pp. 1-638, numerous illustrations.—This volume, the most pretentious of any of the state fish books under review, is an expansion of the same author's *Sea Fishes and Sea Fishing in Louisiana,* which met with such a demand that the supply was soon exhausted. It deals with the freshwater as well as marine fishes of Louisiana. The treatment is popular enough to make the work actually readable: a rare achievement in a fish book. It is really a series of well-written essays, starting off (after quite a number of pages of foreword, preface, etc.) with "Life in the Water," "Classification of Sea Life," "The Mississippi Valley," "Stream Pollution," systematic methods, history of ichthyology, "The Natural History of Fishes," "Life of Fishes," "Types of Fish Eggs," "Food Habits of Fishes," "Fish Parasites," "Poisonous Fishes," "Books for Fish Study" (additional to a good Bibliography), "Preservation of Fish Specimens," and others. A chapter on "Fishing Tackle and its Uses," by Hu B. Myers, is followed logically by "Mosquito Lotions"; then by "State Fish Hatcheries." The fishes are treated with little regard to taxonomic sequence, obviously to make the book attractive to the general reader. Thus the tarpon is treated first and at considerable length among the salt water fishes, while the black basses are accorded a like honor among the freshwater fishes. In addition to a large amount of material of general interest about each important species, gleaned by a long and careful study of the literature, one may find diagnoses and popular keys to all the species recognized, on the self explanatory "if"—"but if" system first used by Walford. Some original information is included, as for instance Miss Genevieve Lee's fine observations (pp. 250-253) on the breeding habits of the sea cats. The smaller and more difficult species, such as the shiners and darters, are left largely aside. Everywhere technicalities are avoided and replaced by items well designed to catch the normal and average human interest. Thus a tale of tarpon angling goes with the account of that species; in the section on the gar the experiments of Burr on gar control by electrocution are quoted at length; the section on *Gambusia* is largely given over to the control of malaria by this fish, etc. Yet a very high "batting average" of accuracy is maintained through the volume. Popular appeal has been increased by the plentiful illustrations, including ten beautiful colored plates reproduced from *The Fishes of Illinois;* a number of half-tones of fishing scenes, the Louisiana state capital and other items in which our southern brethren

take pride, and a large number of zinc cuts borrowed from the government and other sources. A chapter on pond fish culture and a key and a check-list to the families of freshwater fishes close the main part of the book, yet other chapters follow on "Fish and Shrimp Laws" and "The Cookery of Fish and other Sea Foods." All in all, this is perhaps the happiest attempt at a really popular state fish book ever prepared. It is to be hoped that Louisiana will now set out to complete a technical monograph of its fishes, to supplement this popular treatise.

FISHES OF SOUTH DAKOTA. By Edward P. Churchill and William H. Over. The South Dakota Department of Game and Fish, 1933, pp. 1-87, figs. 1-71.—This little handbook resulted from fish surveys by the authors in the summers of 1926, 1927 and 1928, and subsequent laboratory studies. It contains a considerable amount of original information on the distribution, food, habits and importance of South Dakota fishes, along with a digest of previously obtained information. The brief key to the families, and the other keys scattered through the text, are largely in words of one syllable. The descriptions are cut to "field characters," but general information on the biology of each species is included, under several subdivisions. The nomenclature has the advantages and the drawbacks of that adopted in Jordan, Evermann and Clark's 1930 check-list, which was followed. Almost all the work of the last quarter century was disregarded or overlooked by the authors except as it had been registered in the check-list used. Some obvious and serious errors, largely drawn from other authors uncritically followed, are: identification of the brown and rainbow trouts respectively as *Salmo levenensis* and *S. shasta;* use of the name *Moxostoma aureolum* for *M. erythrurum,* and of *M. breviceps* for *M. aureolum;* the inclusion of *Dionda nubila* though the South Dakota records refer to *Hybognathus hankinsoni;* the recognition of *Hybognathus churchilli* Hildebrand, recently described on the basis of some specimens of *H. placitus* sent in for identification by Prof. Churchill; the recognition of *Ceratichthys smithi,* which is a synonym of *Pimephales promelas;* the confusion of two species as *Nocomis kentuckiensis;* the reference of the western specimens of *Rhinichthys cataractae* to *R. dulcis;* recording *"Hybopsis cayuga"* in the West; continuation of the mixup regarding *Notropis blennius;* recognition of *Chrosomus dakotensis,* which is a synonym of *C. eos;* use of *"Notropis dilectus"* for *N. rubellus;* naming the large-mouth bass *Huro floridana,* etc. The illustrations are numerous though crude. Except among the minnows, however, diagnostic features were usually emphasized on the sketches. The figure for the three "minnows with black band" (pp. 48-49) are utterly undiagnostic, unless all were based on the single species *Notropis heterolepis.* Forbes and Richardson's unexplainable error in figuring *Macrhybopsis meeki* as *Platygobio gracilis* is repeated. Despite these blemishes, many of which could have been removed by consulting a specialist on North American freshwater fishes, this state fish book is a valuable and useful publication.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

FIELD BOOK OF THE SHORE FISHES OF BERMUDA.—By William Beebe and John Tee-Van. G. P. Putnam's Sons, New York and London, 1933: 1-xvi, 1-337, 20 pls. (4 col.), 2 maps, 326 figs. $3.50.—This splendid little book though written for popular use, will prove of very material scientific value. Each species of Bermuda shore fish is accorded a common and scientific name, a small outline figure and occasionally a half-tone or colored plate, then a succinct statement of field characters, a short diagnosis, and finally an item on distribution. The systematic treatment is modern and critical. Occasional points of disagreement will occur to interested systematists, but these are few, are generally not very important and are mostly due to following high authority where it has gone astray. Thus the recent ichthyological atrocity of splitting up the sailfishes into local forms is perpetuated. For such the authors should not be blamed. Throughout the book the studious systematic research of Tee-Van is apparent, while the lucid writing of Beebe lends charm to the introduction and to other parts of the book. The brief account of the origin of the Bermuda fish fauna is very interesting and is illustrated by a clever map.

Back of this book are months of field collecting and laboratory research. During these studies, seven new species were discovered, some nominal forms were found to be synonyms or mere color phases, and a number of Bermuda records were found

to be false. The consequent rectifications of nomenclature have been made in *Zoologica.*

All those interested in our marine fishes will look forward to the publication of the extensive natural history studies which the authors have made and are continuing, and to detailed accounts of the rich deep-sea material likewise collected on the Bermuda Oceanographical Expeditions.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

CLASSIFICATION, BIONOMICS AND EVOLUTION OF HOMALOPTERID FISHES. By Sunder Lal Hora. Memoirs of the Indian Museum, Calcutta, 12 (2), 1932: 263-330, pl. 10-12.—Although the peculiar fishes of the family Homalopteridae have long been recognized as one of the most interesting groups of freshwater fishes in southeastern Asia, their classification has not been in a good state. The recent discovery of a number of highly modified forms in China and their careful study by P. W. Fang has only emphasized our lack of knowledge of the family as a whole. Now Dr. Hora, the eminent Indian zoologist, has provided us with an excellent classification of the family in which he has meticulously weeded out the forms erroneously assigned to the group and carefully defined the genera. His work is based on study of the rich materials at Calcutta as well as on type material examined in most of the great European museums and at last gives us a sound basis for work on these most interesting fishes.

Dr. Hora approaches his subject not only from the systematic and phylogenetic angles but from the ecological as well, a combination which is becoming increasingly necessary for the understanding of modern taxonomic problems. His work on Asiatic hill-stream ecology is well known and has especially fitted him to deal with these essentially swift-water fishes.

Dr. Hora divides the homalopterids into two subfamilies (Homalopterinae and Gastromyzoninae) on the basis of the number of undivided pectoral rays, supported by osteological characters verified in a few genera. In each section we find a comparable series of genera ranging from an elongate, comparatively compressed type like *Homaloptera* to broad and greatly flattened ones with the pectoral and pelvic fins highly modified to form a sucking disk by which they adhere, limpet-like, to the rocks of mountain torrents. Added to the generic diagnoses there are in some cases descriptions of new or poorly understood species. Seven new genera are described and several hitherto placed in synonymy are resurrected. It is unfortunate that Mr. Fang's latest paper on Chinese Homalopterids (Sinensia, 1931, 2, No. 3: 41-64), describing several new species and revising the genera *Beaufortia* (=*Gastromyzon* of Fang) and *Sinogastromyzon,* was not in Dr. Hora' hands at the time his paper went to press.

Of the Chinese *Lepturichthys,* a single species of which has been known, two new forms are diagnosed by Dr. Hora. One of these (*L. nicholsi*) is defined by the presence of "wart-like spinous processes" over the dorsal surface of the head and body. While *L. nicholsi* is perhaps valid, a specimen of this type in the National Museum strongly indicates that the "processes" may be nothing more than nuptial tubercles.

The locomotion, respiration, feeding, and evolution of the genera are discussed at greater or lesser length. Dr. Hora is of the opinion that the homalopterids are probably of polyphyletic origin, the Homalopterinae being derived from the Cyprinidae and the Gastromyzoninae from the Cobitidae. He is, furthermore, convinced of the direct effect of the environment in shaping the evolution of these fishes and of other hill-stream animals. The work ends with a complete bibliography of homalopterid literature and three beautiful plates illustrating most of the genera.

While we may or may not agree with Dr. Hora in the derivation and method of evolution of the Homalopteridae I think all will concede that his monograph is one of the most interesting and valuable ichthyological contributions of recent years. —GEORGE S. MYERS, *United States National Museum, Washington, D.C.*

LABORATORY MANUAL OF THE ANATOMY OF THE SPINY DOGFISH. By Edgar L. Lazier, Edwards Brothers, Inc., Ann Arbor, Michigan. 1933, pp. 1-55, fig. 1-23.—This manual is interesting typographically as an example of "litho-

printing": reproduction by a photographic process directly from the typed or drawn copy. It gives a rather thorough and clearly worded description of the entire anatomy of *Squalus*, and should prove helpful as a reference work as well as manual. The pedagogic method is that of "Here, little boy, close your eyes and take this nice medicine," which the author obviously believes justified by experience. It is certainly in line with the modern tendency to sacrifice learning how to discover for the cramming down of the ever increasing mass of information which the student really needs to know. Which method is superior the reviewer does not venture to guess.—CARL L. HUBBS, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

FISH SKULLS: A STUDY OF THE EVOLUTION OF NATURAL MECHANISMS. By William K. Gregory. Transactions of the American Philosophical Society. Vol. XXIII, 1933, pp. vii + 75-481, 302 figs.—The study of the skull of the teleosts has been rendered difficult because of the wealth of varied types which this complex group contains and because the isolated phylogenetic position of the teleosts has rendered difficult the comparison of their structures with those found in higher vertebrates. We have had in the past many excellent descriptions of particular teleost skulls; but there have been few attempts to synthesize the material, to interpret the evolutionary history of the skull within the teleosts or to correlate the cranial structures of these forms with that of other major vertebrate groups.

Recent work by Gregory, Stensiö and Watson among others, has laid a solid paleontological foundation for the study of cranial history. Most of these studies have been concerned with the skulls of the more primitive fish types and their relations to the main line of evolution leading to land forms. In the present monograph Dr. Gregory applies this newer knowledge to the elucidation of the particular problems of the teleosts. The first 60 pages of this study are devoted to a general description of the skull in fishes as a whole, followed by a section which outlines the skull history of the earlier actinopterygians. The main body of the work—some 280 pages—is devoted to an abundantly illustrated comparative description of the skull of every major group of teleosts. The evolution of these varied skull types is considered, and a phylogenetic arrangement of the teleosts is suggested on the basis of this study. A final series of sections treats of the skull as a mechanism and the evolutionary processes which may have been concerned.

It is fortunate for students of the fishes that Dr. Gregory has turned aside from the studies in human evolution in which he has been mainly interested of recent years to devote his remarkable powers of synthesis to the production of this extremely valuable and stimulating monograph.—ALFRED S. ROMER, *Walker Museum, University of Chicago, Chicago, Illinois.*

VERTEBRATE PALEONTOLOGY. By Alfred Sherwood Romer. University of Chicago Press, May, 1933, pp. i-vii + 1-491, figs. 1-359. $5.00.—"The story of vertebrate evolution as revealed by the study of fossils is one of interest not only to the paleontologist but to those engaged in other branches of science—to the geologist and to the worker in many fields of biology. The present volume was undertaken because of the lack of any modern work in English dealing with the subject as a whole. . . . During recent decades our knowledge of vertebrate fossils has increased greatly, but the new facts and the new concepts based on them have been but slowly taken up in general biological or geological literature." (From the Preface.)

The treatment is according to systematic sequence. Groups of debated position are given a definite place in the system, with little reference to alternative theories. The detailed evidences for alternative views are largely omitted through the book, as the author relies on a rather extensive annotated bibliography to lead the student into the literature. All this should help in the mastery of the volume by the student, but may give him an erroneous idea that the subject matter of vertebrate paleontology, anatomy and taxonomy is simplified and fixed. Whether a less simplified treatment, with the presentation of alternative hypotheses and the leaving open of the more disputed questions, would be preferable is of course a pedagogic question. The reviewer always avoids such.

The "Introductory" chapter gives a very elementary and brief account of fossils, the geologic time scale, evolutionary theories (the Darwinian explanation of natural selection is accepted), taxonomy and classification, vertebrate structure and vertebrate classification,—all on 21 pages. Whether these general discussions should not have been materially expanded, even though at the expense of subsquent detail, raises another pedagogic question.

Romer very logically divides the vertebrates into two "super-classes," Pisces and Tetrapoda. The Pisces he divides into Agnatha, Placodermi, Chondrichthyes and Osteichthyes. A detailed classification of the fishes, amphibians, reptiles and of higher vertebrates, synoptic both geologically and geographically, is given in a concluding chapter.

Chapter II, "Primitive Jawless Vertebrates" makes readily available for the student and general biologist the main results of the classic researches of Stensiö and Kiaer on the Agnatha. Chapter III deals briefly with the placoderms and sharks (Romer's Chondrichthyes). The fourth chapter briefly treats the other fishes, the Osteichthyes of Romer's scheme. About 70 pages in all are devoted to Pisces.

The Amphibia are accorded one chapter (V) of 27 pages, while the Reptilia are given five chapters comprising 105 pages.

Each chapter is illustrated by numerous clear-cut line drawings, mostly reconstructions so perfect that the student might be pardoned for getting the idea into his head that fossils come that way out of the ground. But this is all in line with the ideal of simplification adopted by the author. The phylogeny of each main group is illustrated by well drawn diagrams, showing the origin and subsequent history of each subgroup, with an indication, by the varied width of the ascending line, of the degree of development of the group at each geologic time.

The writer's style lends itself to easy understanding, though technical terms are not particularly avoided. While the degree of technicality does not appeal to the reviewer carried too far, it does seem out of harmony with the rigidly simplified treatment of the conclusions, based on the technical information.

The press work is excellent, as would be expected.

I recommend this book highly to ichthyologists and herpetologists, as well as to teachers of these subjects and of comparative anatomy, vertebrate paleontology and vertebrate zoology.—Carl L. Hubbs, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

EDITORIAL NOTES AND NEWS

Summary of the 1933 Meeting

THE sixteenth annual meeting of the AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS was held at the Museum of Comparative Zoology, Cambridge, Massachusetts, from Thursday, May 11, to Saturday, May 13, 1933. An innovation at this meeting was the division of the program into separate sessions for ichthyology and for herpetology. In spite of adverse conditions, the total number in attendance at the two sessions reached gratifying figures, varying from fifty to sixty.

Sessions of May 11

The herpetological program opened at 10:00 A.M. in the Whitney Library of the "M.C.Z.," with Vice-President BISHOP presiding. Mr. ARTHUR LOVERIDGE made a short address of welcome on behalf of Dr. BARBOUR. The following papers were read and discussed:

1. **The relationships of some neotropical colubrine genera**—E. R. Dunn.
2. **Notes on the feeding habits of Tropidophis melanurus in captivity**—Miss Isabel Hoopes.
3. **The snakes commonly identified as Trimeresurus gramineus**—C. H. Pope.
4. **The genus Leiocephalus in Cuba**—Benjamin Shreve.
5. **Survival value of specific anatomic characters in Rana palustris**—E. R. Dunn.
6. **Observations on limb development in Rana sylvatica**—A. E. Warren.
7. **A neglected herpetologist and his work**—C. H. Pope.

The ichthyological session opened at 10:00 A.M. in the Paleontological Laboratory of the "M.C.Z.," with Dr. HUBBS presiding. The following papers were read and discussed:

8. **The distribution of the freshwater fishes of Mexico**—C. L. Hubbs.
9. **Report on studies of hybridization between fish species**—C. L. and L. C. Hubbs.
10. **The fisheries biologist at sea**—W. C. Herrington.
11. **Peculiarities in the life history of the mackerel**—O. E. Sette.

Both sessions adjourned at 12:15 and met in the Auditorium of the Biological Institute to see a presentation of "High Speed Photography in Biology" by H. E. EDGERTON. This remarkable film showed the manner in which a cat turns in the air when falling, as well as the detailed movements of a snake's tongue photographed at the rate of 250 exposures per second. Immediately following, members attended a luncheon at the Faculty Club of Harvard University in company with members of the American Society of Mammalogists, who were meeting simultaneously at Cambridge.

Business Meeting

Vice-President BISHOP called the annual business meeting to order at 3:00 P.M. with 24 members and 5 Governors present. The Secretary read the minutes of the 1932 meeting and these were duly approved.

The report of the TREASURER, covering the period from May 4, 1932 to May 6, 1933, was read and approved. Receipts for this period were $1,956.38, distributed as follows: cash balance May 4, 1932, $426.77; annual dues, $894.70; annual subscriptions, $108.80; sale of reprints, $292.59; sale of back numbers, $155.01; miscellaneous gifts, $57.77; and suspense, $21.40. Expenditures for the same period were $1,333.15, allocated as follows: publication of Copeia (3 numbers only) $952.32; printing of reprints, $215.97; photostating back numbers, $100.22; postage, $38.37; stationery, etc., $26.27. The balance, as of May 6, 1933, was $623.23 and the only outstanding obligation was the bill for the printing of the April number of Copeia.

The SECRETARY reported that the Society was weathering the depression in a very gratifying fashion for the net loss in members and subscriptions during the year was only 14, or 3% of the total roll, whereas other scientific societies sustained

losses ranging from 10% up. There were 365 members and 68 subscribers at the beginning of the year; 5 members were lost by death, 21 resigned, 22 were dropped for serious arrears in dues, and 8 subscriptions were cancelled. However, 33 new members and 9 new subscribers were added during the period so that the total enrollment, as of May 11, 1933, was 350 members and 69 subscribers.

A geographical analysis of the members and subscribers of the Society showed that 71 copies of Copeia went to 21 foreign countries. Canada led with 21 members and subscribers, while England, Germany, Japan, and the U.S.S.R. followed with 6 each. 348 copies went to 40 states and the District of Columbia. New York State led with 57 members and subscribers, California followed with 42, Michigan with 27, Pennsylvania with 26, District of Columbia with 25 and Massachusetts with 23.

The SECRETARY reported that one-third of the ballots on the time of meeting had been returned. (Detailed figures of the votes are available to any member who desires them but lack of space prevents their being given here.) In summary, of the entire membership in North America, almost twice as many favored the spring meeting, and of the membership east of the Mississippi, more than three times as many persons expressed their preference for a spring meeting rather than for a winter meeting with the American Association for the Advancement of Science.

Dr. HUBBS presented the report of the EDITORS, the acceptance of which was followed by a short discussion of the policy of permitting authors to pay part, or all, of the cost of publication. Dr. Hubbs stated that the suggestion was applicable only to long articles or articles requiring numerous illustrations. In some instances members who desired prompt publication have paid the cost of the required extra pages. The present size of Copeia is controlled solely by the funds available, for the Editors have sufficient material on hand for a full year. Under these circumstances every extra dollar contributed by authors or institutions increases the amount of printing which can be done.

The newly elected officers for 1933-34 are: *Honorary Presidents,* JOHN TREADWELL NICHOLS (Ichthyology) and LEONHARD STEJNEGER (Herpetology); *President,* G. K. NOBLE, *Vice-Presidents,* GEORGE S. MYERS, ARTHUR LOVERIDGE and MYRON GORDON; *Secretary,* M. GRAHAM NETTING; *Treasurer,* ARTHUR W. HENN; *Ichthyological Editor,* CARL L. HUBBS; *Herpetological Editor,* Mrs. HELEN T. GAIGE.

The chairman called for reports from the various standing committees but most of the committees had no matters of importance to report. The Secretary reported that the Committee on the Constitution had remained inactive during the year at his request, since the officers did not consider it advisable to put the Society to even the small expense of incorporation during the present critical period.

Nineteen new Governors were elected to the Board, bringing this body up to its maximum of fifty persons, and thirty-three new members were formally added to the membership roll.

The chairman appointed a Committee on Resolutions. He also appointed Dr. Carl L. Hubbs, Dr. George S. Myers, and Dr. John R. Greeley to constitute a Standing Committee on Methods of Counting and Measuring Fish.

The Secretary presented the following amendment to the By-Laws which was voted upon, and accepted:

Resolved, that Article III, shall be amended by the addition of the following Section: "Section 3. Upon payment of $75.00 any member may become a Life Member. The amount may be paid in one sum or in not more than three annual payments of $25.00 each. All sums paid by Life Members must be kept in a separate account during the lifetime of the Member, and only the income is to be used by the Society during this period. Upon the death of a Life Member the principal may be transferred to the currency account of the Society."

Dr. Bishop read a letter from Dr. A. AVINOFF, Director of the Carnegie Museum, inviting the Society to hold its 1934 meeting in Pittsburgh. Since the American Society of Mammalogists had received a similar invitation too late, and had voted to hold its next annual meeting in New York City, a motion was passed to hold the 1934 meeting in New York City and the 1935 meeting in Pittsburgh.

At 7:00 P.M. the joint dinner of the two societies was held at the Harvard Faculty Club. After the presentation of the newly elected Presidents, and brief remarks by outstanding guests, the members were entertained with motion pictures of African Elephants by Gouverneur M. Phelps, Jr., and of Blue Sheep hunting in Western China, by Brooke Dolan.

Sessions of May 12

The second herpetological session opened at 10:00 A.M. in the Whitney Library with the newly elected president, Dr. G. K. NOBLE, in the chair. The following papers were read and discussed:

12. **Some peculiar secondary sexual characters of Salientia**—Ch'eng-chao Liu.
13. **The systematic statue of Lithodytes latrans Cope**—E. R. Dunn and Jean Piatt.
14. **The courtship of the tiger salamander**—Miss K. F. Kumpf.
15. **Remarks on photography of alcoholic specimens**—C. V. MacCoy.
16. **Experiments on the brooding habits of Eumeces and Ophisaurus**—G. K. Noble and E. R. Mason.
17. **The nests and young of Desmognathus fuscus ochrophaeus Cope**—S. C. Bishop and H. P. Chrisp.
18. **The nocturnal activities of salamanders**—M. G. Netting.
19. **Influence of a montane environment on reproduction of Amphibia**—A. Loveridge.
20. **The coloring of biological lantern slides**—M. G. Netting.

The ichthyological session of May 12 was called to order in the Paleontological Laboratory at 10:00 A.M. by Dr. HUBBS. The following papers were read and discussed:

21. **Unusual specimens of the common mackerel (Scomber scombrus)**—F. E. Firth.
22. **Recent developments in fish methods**—R. S. Nesbit.
23. **Migrations of New England cod**—W. C. Schroeder.
24. **The distribution of pelagic stages of haddock in the Gulf of Maine**—L. A. Walford.
25. **The function of the deposits of guanin in the organism of fish**—I. I. Ostromislensky (communicated by N. A. Borodin).
26. **A new Australian marine fish**—N. A. Borodin.
27. **Australian lung fish (Neoceratodus forsteri), its propagation and rate of growth**—N. A. Borodin.
28. **Freezing and reviving fish**—N. A. Borodin.

At the conclusion of the formal session, the last three papers were illustrated by a very interesting demonstration.

The members again lunched at the Faculty Club with the members of the American Society of Mammalogists.

At 3:30 P.M. both the Ichthyologists and Herpetologists gathered in the auditorium of the Boston Society of Natural History, where the two final papers on the program were read. These very interesting contributions were:

29. **Polymorphism in related species of fishes and its genetic basis**—Myron Gordon
30. **The distribution of oviparous cyprinodonts and the problem of a Tertiary African-South American land bridge**—G. S. Myers.

At the conclusion of the reading of papers, the Resolution Committee, consisting of Dr. G. K. Noble (chairman), Mr. C. W. Coates, and Dr. Carl L. Hubbs, presented the following resolutions which were passed by the Society. A resolution of thanks to the Local Committee, and to the authorities of the Museum of Comparative Zoology and of the Boston Society of Natural History, was also passed.

Whereas, present economic conditions have necessitated a rather drastic curtailment of federal scientific activities, and

Whereas, we regard the scientific, educational and conservational activities of the Bureau of Fisheries, the National Museum and the National Zoological Park, and of other federal agencies engaged in such work, as being vital to the national welfare,

Therefore, be it resolved that the American Society of Ichthyologists and Herpetologists urges Congress and the Administration to maintain these activities at as high a level as is consistent with financial conditions.

Whereas, recent motion pictures showing distinct errors in regard to fish and reptiles, especially snakes, have been exhibited in public theaters,

Therefore, be it resolved that the American Society of Ichthyologists and Herpetologists meeting in convention at Cambridge, Massachusetts, May 11th to May 13th, 1933, enters a protest against the production of such pictures and recommends to the motion picture industry that competent technical advice be secured so that the scenes depicted will be true.

At the adjournment of this meeting the members were delightfully entertained by the Director and Staff of the Museum of the Boston Society of Natural History at an afternoon tea. Following the tea, members had an opportunity to see the interesting exhibits in the building.

At 8:30 P.M. the members had the pleasure of attending the feature lecture of the American Society of Mammalogists. This was delivered by Dr. HARRY C. RAVEN in the auditorium of the Institute of Geographical Exploration. Dr. Raven presented movies of his pet chimpanzee "Meshie," who also made a personal appearance.

The Society wishes to express its appreciation of the prominent part taken by the local staff of the Bureau of Fisheries in contributing toward the marked success and interest of this meeting.

Many of the members remained in Cambridge until Saturday or Sunday in order to examine specimens at the Museum of Comparative Zoology. Part of the group met again informally, at the museums and aquaria in New York, Philadelphia and Washington.

Meeting of the Western Division

THE fifth annual meeting of the Western Division of the Society was held from Monday, June 12, to Thursday, June 15, 1933, at the University of Utah, in connection with the meeting of the Pacific Division of the American Association for the Advancement of Science. The following papers were read:

1. **Herpetological habitats and life zones in Mexico.** Paul D. R. Ruethling, Santa Fe, New Mexico.—Temperature and water seem chief factors determining life zones in Mexico. Temperature varies according to latitude, elevation, and exposure, causing greater restrictions to distribution than light, atmospheric pressure, and other minor factors; and is of great influence in molding environment and creating barriers. A brief sketch is given of the west coast, Lower California, east coast, central plateau, and isolated alpine regions, together with comments on the herpetological fauna typical of these distinct regions.

2. **A plea for the systematic lumper.** Rolf L. Bolin, Hopkins Marine Station, Pacific Grove, California.—There exists too large a proportion of monotypic genera, a considerable number of which should be lumped in order to best display the relationship of the forms in question.

3. **Distribution of the fishes of Oregon and Washington.** L. P. Schultz, University of Washington, Seattle, Washington.—347 species of fish have been taken in this area, 255 marine, 75 fresh-water, and 17 common to salt and fresh water. 21 species of marine fish have not been found outside the area; 11 of these occur in Puget Sound. The Columbia River has 33 native species and 16 introduced. In general the fauna of the coast of Washington, Puget Sound, and the coast of Oregon as far south as the Sixes River was derived from the Columbia River. The Rogue River, Klamath River, and Oregon lakes possess a distinct fauna.

4. **A study of the variation of the dorsal scale rows of Charina bottae (Blainville).** Vasco M. Tanner, Brigham Young University.—This paper is published in the current number of COPEIA.

5. **Notes on the native fish fauna of Utah.** Vasco M. Tanner.—Utah has mainly two drainage basins, the Great Basin or Bonneville Basin, and the Colorado River Basin. 29 native species, 23 introduced species, and 7 fossil species are reported.

6. **Notes on the castosmids of Utah.** Merril C. Hammond, Brigham Young University.—In the Colorado River system are found *Xyrauchen texanus, Catostomus latipinnis, C. insignis, Notolepidomyzon utahensis,* and *N. delphinus. Pantosteus platyrhynchus* is found in the Provo, Sevier, and Weber rivers. *Pantosteus virescens* is common in the Weber and Bear rivers. *Catostomus ardens* may be a synonym of *C. fecundus; Chasmistes liorus* may be only a variant of *Catostomus fecundus.*

7. **The mechanism of fang replacement in the rattlesnake.** L. M. Klauber, Natural History Museum, San Diego, California.—On each side of the head there is a pair of contiguous maxillary fang sockets. These are used alternately to hold the active fang, the immature fangs being held in a magazine in a staggered line behind the two sockets, the most mature of the future fangs being behind the vacant socket. When the time comes for a change this fang advances to the vacant socket anterior to it and becomes seated therein. The old fang drops out, leaving a vacant socket, to which, in due time, the next replacement advances.

8. **Notes on some Washington Amphibians.** James R. Slater, College of Puget Sound.—*Ambystoma tigrinum* has been taken in the larval condition in Sulphur Lake and Medical Lake, Washington, in large numbers at Medical Lake. *Rhyacotriton olympicus, Ascaphus truei, Ambystoma paroticum* and *Bufo boreas* were taken at Spirit Lake, Washington. *Plethodon intermedius* was taken north of any previously reported locality, near Pokum, British Columbia.

9. **The Muellerian duct of the male Triturus torosus.** Lawrence E. Griffin and Henry Wu. Reed College, Portland, Oregon.—The Muellerian duct of the male *Triturus* is an extremely slender tube which extends the length of the abdominal cavity, and has a definite lumen as far as its anterior extremity.

10. **Infection with amphibian tubercle bacilli connected with a case of sex reversal in a frog.** Lawrence E. Griffin, Reed College, Portland, Oregon.—A testis of normal appearance and connections replaced the right ovary. In the testis were found numerous masses of bacteria which have been identified as amphibian tubercle bacilli.

11. **Some changes in the blood of certain Caudata, Triturus torosus, during desiccation.** Alice H. Bramlett and F. M. Baldwin, University of Southern California.—A study made to discover the degree of desiccation as indicated by changes in concentration of blood cells, increase in specific gravity, and coagulation time. Rapid desiccation is fatal. In some cases death results when 32% of the body weight is withdrawn in 14 hours. When desiccation was carried out slowly, some lived 54 hours with a loss of weight of 38%.

12. **Notes on a new cyprinoid genus, Pseudogyrinocheilus; and P. procheilus (Sauvage and Dabry) from western China.** P. W. Fang, Metropolitan Museum of Natural History. Nanking, China.—A detailed analysis and description of the new genus and of the species assigned to it.

An exhibition of living reptiles of Utah was prepared by Professor VASCO M. TANNER and Mr. D. ELDON BECK.

Officers for the coming year were elected: *President,* Dr. VASCO M. TANNER; *Vice-President,* Professor TRACY I. STORER; *Secretary,* Prof. ARTHUR SVIHLA.

The following resolution of respect for Dr. BARTON W. EVERMANN was passed:

As members of the Western Division of the American Society of Ichthyologists and Herpetologists we wish to express our deep regret at the passing of Dr. Barton Warren Evermann, our President.

We recognize Dr. Evermann as a great scientist, leader, and one of the last of the 'Old Guard' who pioneered zoological work of western America.

We shall long remember and appreciate his work as director of the California Academy of Sciences and the Steinhart Aquarium. He was active and energetic in behalf of the Academy to the very end. He was always faithful to his host of friends. Under his vigorous and wise directorship the Academy now stands as one of the most notable institutions of its kind in America.

Meetings of New York Members

THE APRIL meeting of the New York members, held on the 7th inst. at the laboratory of Dr. HOMER W. SMITH, featured a symposium on the dipnoan fishes. Dr. Smith discussed *Protopterus* and showed living specimens, swimming and in aestivation. Dr. GREGORY discussed the phylogeny of the group and others took part in the general discussion.

On May 3 the local members met at the American Museum, where CLIFFORD POPE lead a discussion on the life histories of Asiatic snakes.

Pacific Science Congress

THE FIFTH PACIFIC SCIENCE CONGRESS, held in June at Vancouver, featured papers on fisheries biology and ichthyology. Dr. R. E. FOERSTER reports that the fisheries papers, comprising six general sections, proved intensely interesting and extremely valuable to those in attendance. The inability of any of the fisheries workers of Japan, China or the Soviet Republics to attend was much regretted.

Bureau of Fisheries

THE wave of economy which is inundating the federal scientific services in general has forced a curtailment in some of the scientific work in the Bureau of Fisheries. Fortunately the decrease in funds and in investigations will not be as disastrous as had been indicated at an earlier date.

The Commissioner of Fisheries, HENRY O'MALLEY, despite his years of effective administration has been replaced by FRANK T. BELL, but retains a position in the Bureau. The Deputy Commissioner, LEWIS RADCLIFFE, favorably known among both ichthyologists and fishery scientists, has been replaced by CHARLES E. JACKSON.

The new Commissioner, whom the Society greets with hopes for a successful administration, is now inspecting the Bureau's extensive operations in Alaska, accompanied by Prof. WILLIS H. RICH of Stanford University as a technical advisor.

Dr. S. F. HILDEBRAND, senior ichthyologist of the U. S. Bureau of Fisheries, has been "loaned" to Mississippi to make investigations on which to base a scientific program for fish conservation and propagation in Mississippi, following representations to the Bureau from the State Fish and Game Commission and the congressional delegation of that state asking for assistance in securing information on spawning seasons of the various fish. It is gratifying to learn that the last of the states now has an organized State fish administration.

Herpetological Items

THE memory of JOHN KERN STRECKER, curator of the Baylor University Museum, was honored at Waco, Texas, on April 20, in a special service arranged by the Texas Academy of Science and participated in by the entire university. Eulogies were presented by H. B. Parks, of San Antonio, formerly state entomologist and secretary of the academy, and by Dr. Walter J. Williams, professor of mathematics, who was intimately associated with Mr. Strecker. The complete works of Mr. Strecker, assembled by the academy and bound in leather, were presented to the Baylor University Library. Included were ninety-three contributions on mollusks, reptiles, birds and mammals. About twenty papers, incomplete at the time of his death, will be brought to completion by Dr. Williams and published as soon as possible. Mr. Strecker's death occurred at Waco on January 9.—From *Science*.

COPEIA is happy to announce the appointment of Dr. Walter J. Williams to the curatorship of the Baylor University Museum, left vacant by the death of Mr. Strecker. Dr. Williams is carrying on field studies in western Texas during the summer.